Introduction

Delta modeling studies for CalFed alternatives 2B, 2B_AH1 and 2B_AH2 were completed using DWRDSM2. These simulations used the same DWRSIM study 532a. The DWRSIM study in this report assumed zero trigger for Sacramento River flow for NDSS or NDES diversions. Hydrodynamics and water quality changes in the Delta were analyzed when North Fork of Mokelumne River improvements were replaced with South Fork improvements. The purpose of this report is to describe and present these study results.

Comparison of flows, electrical conductivity, and minimum water level elevations in selected locations in the Delta are presented in this report. Results will be provided at the Delta Modeling Section web page at http://wwwdelmod.water.ca.gov.

CALFED Alternatives

Alternative 2B

Hydrology used for this alternative was DWRSIM study 532a. The geometry and the delta facility operations for this study was identical to the January 16, 1998 study. However the amount of water diverted from Hood to Snodgrass slough was different from the January study. For this study, Hood diversions were constrained by a minimum Rio Vista flow of 3,000 cfs in July, August, and September. In addition, Hood diversion was limited to 5,000 cfs in May due to migrating fish concerns (Map 1).

Alternative 2B_AH1

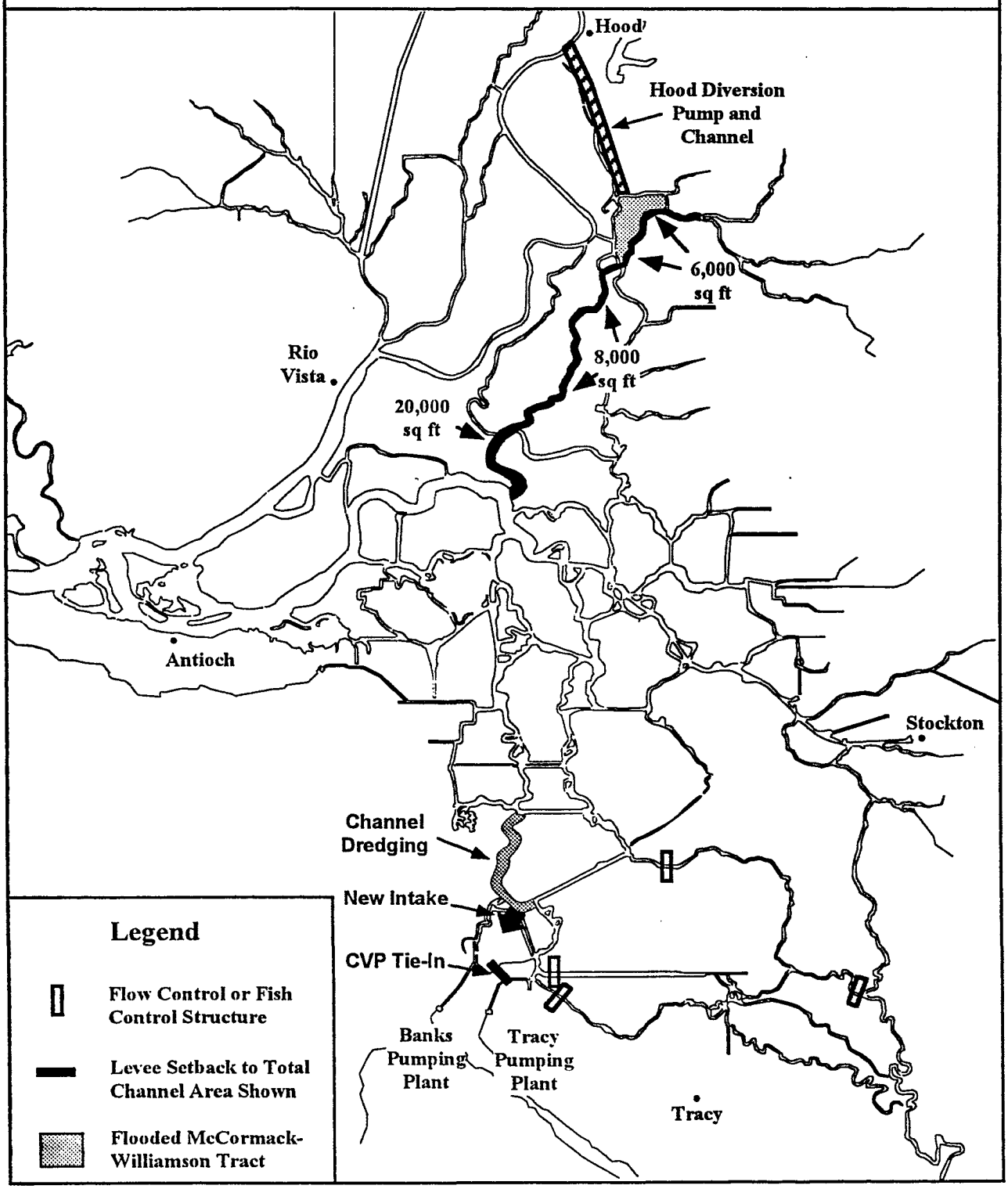
Hood diversion to Snodgrass Slough, ISDP improvements, South Delta and CCFB gate operations, Suisun Marsh gate operations, Delta Cross Channel operations and DWRSIM hydrology were identical to Alternative 2B. Enlargement of the Snodgrass Slough by 1,000 foot levee setback and flooding of McCormack Williamson tract are common to all three Alternatives 2B, 2B_AH1 and 2B_AH2. Channel enlargements done in the North fork of the Mokelumne for Alternative 2B were not included for this alternative, and instead South Fork of Mokelumne was enlarged. Two thousand feet levee set backs were introduced from western New Hope tract along South Fork of Mokelumne River, east of Bouldin island and Empire tract up to San Joaquin River (Map 2).

Alternative 2B_AH2

Geometry and Hydrology are very similar to Alternative 2B_AH1. However, throughout the simulation Georgiana Slough and the Delta Cross Channel were kept closed (Map 3). Because Georgiana Slough and Delta Cross Channel were closed, more water could be

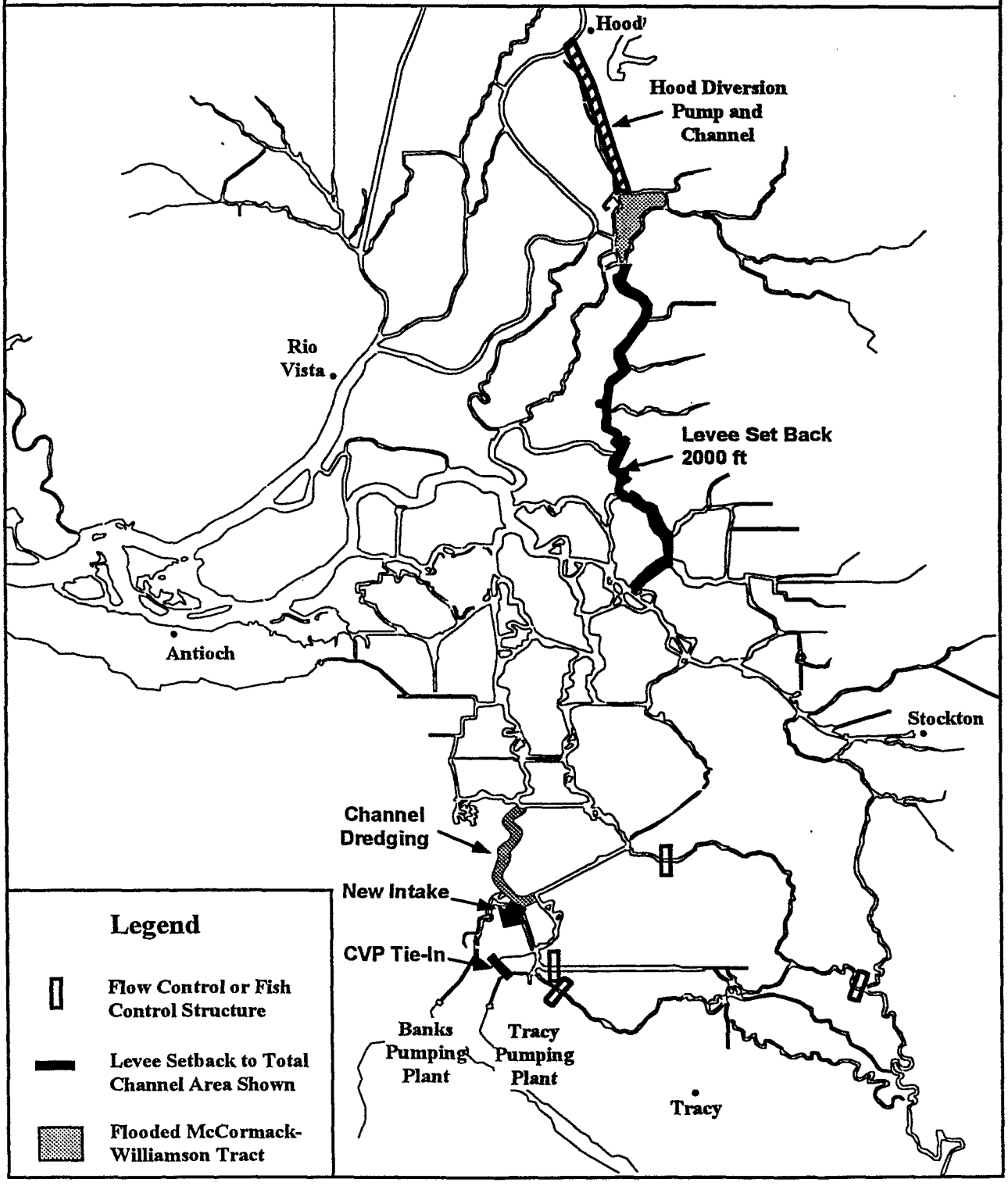
Map 1

Alternative 2B



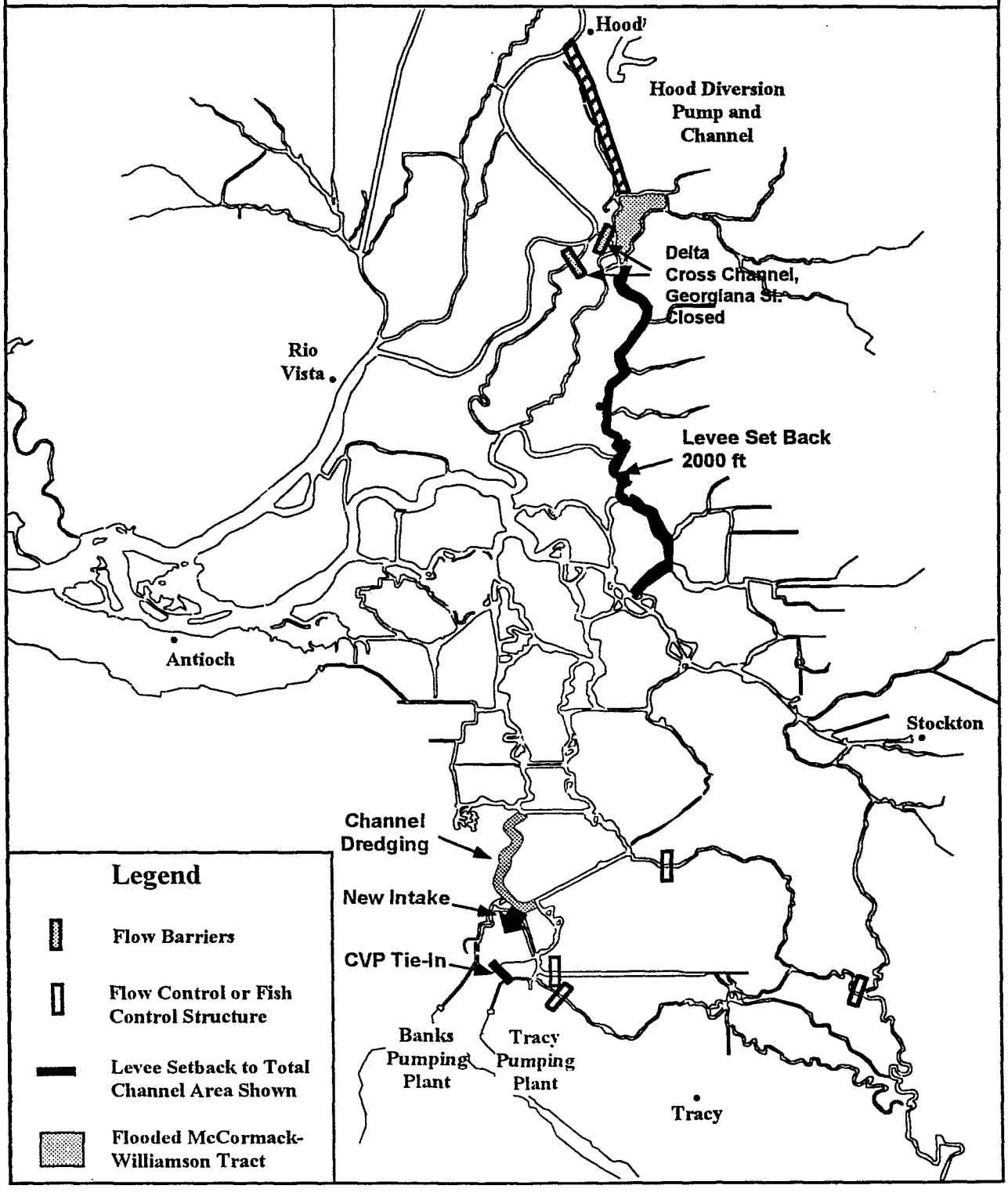
Map 2

Alternative 2B_AH1



Map 3

Alternative 2B_AH2



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pumped from Hood in months of July, August and September without violating the Rio Vista flow criteria (Table 1-2 of the appendix)

General Modeling Assumptions

Delta Boundary Conditions

The boundary of the Sacramento-San Joaquin Delta as modeled by DWRDSM2 consists of the Sacramento River at I Street, the San Joaquin River at Vernalis, and Carquinez Straight at Martinez.

Downstream Stage - The 19-year mean tide was used to generate the Delta tidal action contributing to the Delta hydrodynamics and water quality. This 25-hour sequence was repeated throughout the 16 year study period.

Delta Inflows and Exports - Delta inflows and exports were obtained from DWRSIM study 532a. This study assumes a 2020 level of development. For this analysis 16 years of hydrology (1976-1991) were used. Important Delta boundary flows are summarized in the Table 1-1 of the appendix.

Delta Boundary Salinity - salinity at downstream boundary at Martinez and at upstream locations of Sacramento River at I Street, Yolo Bypass inflow to Cache Slough, San Joaquin River at Vernalis, and east side stream inflows need to be determined. The salinity at Martinez is calculated by an artificial neural network model developed by DWR. This model derives electrical conductivity at Martinez as a function of Delta outflow. Similarly, the electrical conductivity at Vernalis varies with the flow and flow source in the San Joaquin River.

Delta Facilities Operation

Clifton Court Forebay Intake Gates - Identical for all three alternatives. (see Table 1-2 of the appendix)

Suisun Marsh Salinity Control Gates - Identical for all three alternatives. (see Table 1-2 of the appendix)

South Delta Flow and Fish Control Structures - Identical for all three alternatives. (see Table 1-2 of the appendix)

Delta Cross Channel - Cross Channel gate operations are similar for alternatives 2B and 2B_AH1. For Alternative 2B_AH2, the cross channel gates were closed throughout the simulation period.

Highlights of Modeling Results

Flow

Monthly average flows are presented for each alternative in this report for 16 locations in the Delta. For the purpose of this brief evaluation, monthly average flows are averaged over the 16 year period (see Figures 1-16). The selected 16 locations are shown in Map 4.

Cross Delta flow - Cross delta flow is generated by the sum of flows in the Georgiana Slough, Delta Cross Channel and Hood diversion to Snodgrass Slough. Because Georgiana Slough and Delta Cross Channel were closed for Alternative 2B_AH2, the Cross Delta flows are lower for this alternative in all months except September (Figure 1). In the month of September more water is pumped from Hood in Alternative 2B_AH2 than the other two (Table 1-2 of Appendix). For the period where the Delta cross channel is open (July-October) Alternative 2B_AH1 had a higher Cross Delta flow than Alternative 2B. This shows that flow through the Delta Cross Channel is higher when south fork of Mokelumne is improved.

Qwest - The values of Qwest for Alternatives 2B and 2B_AH1 are similar. Qwest for Alternative 2B_AH2 was observed to be lower than the other two alternatives (Figure 2). In the months of July and August negative Qwest is observed for Alternative 2B_AH2 thus causing ocean salt to enter into some parts of the Central Delta (see Figure 31).

Rio Vista - Because Georgiana Slough and Delta Cross Channel were closed for the Alternative 2B_AH2, more water was available to flow along the Sacramento River. Thus a higher flow at Rio Vista for this alternative (Figure 3).

Georgiana Slough - As expected flow in Georgiana Slough for Alternative 2B_AH2 is zero. Alternative 2B had higher flows than Alternative 2B_AH1 (Figure 4). The reason for this could be channel improvements downstream of Georgiana Slough (Mokelumne near Andrus Island) in Alternative 2B.

North Fork and South Fork of Mokelumne - As expected high flows were observed in the North Fork for Alternative 2B and high flows were observed in South Fork in Alternatives 2B_AH1 and 2B_AH2 (Figures 5 & 6). Higher head gradient along the North Fork when Delta Cross Channel and Georgiana Slough were closed could be attributed for slightly higher flow values along the North Fork in alternative 2B_AH2 over 2B_AH1.

Mokelumne River - As expected Alternative 2B had the highest and Alternative 2B_AH2 had the lowest in Mokelumne River near Andrus Island (Figure 7).

Little Potato Slough - As explained before more water was diverted along the North Fork in Alternative 2B_AH2 than Alternative 2B_AH1. Therefore, Alternative 2B_AH2 had lower flow in Little Potato Slough than in Alternative 2B_AH1 (Figure 8).

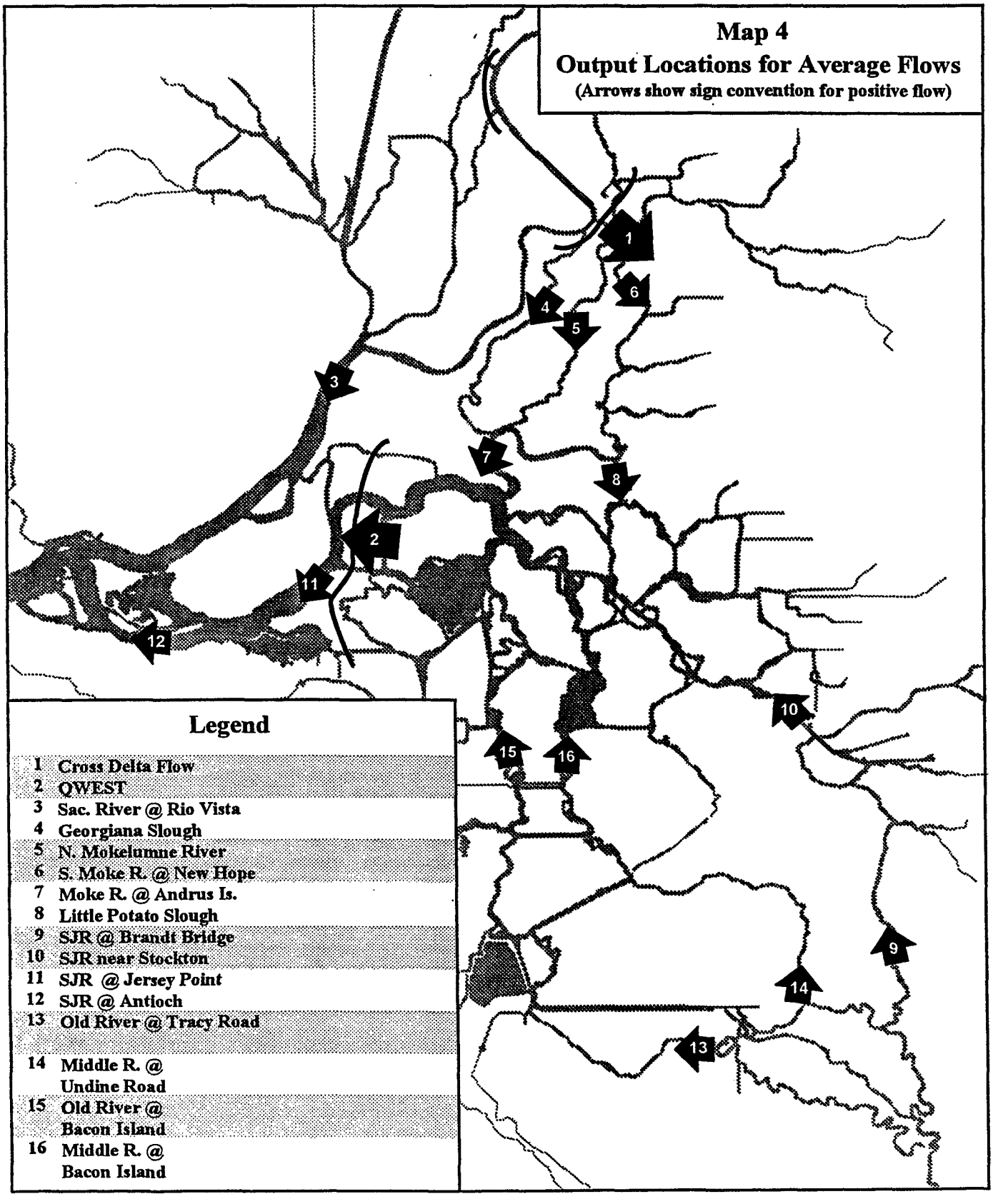


Figure 1: Cross Delta Flow (Monthly Average Flow)
(comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

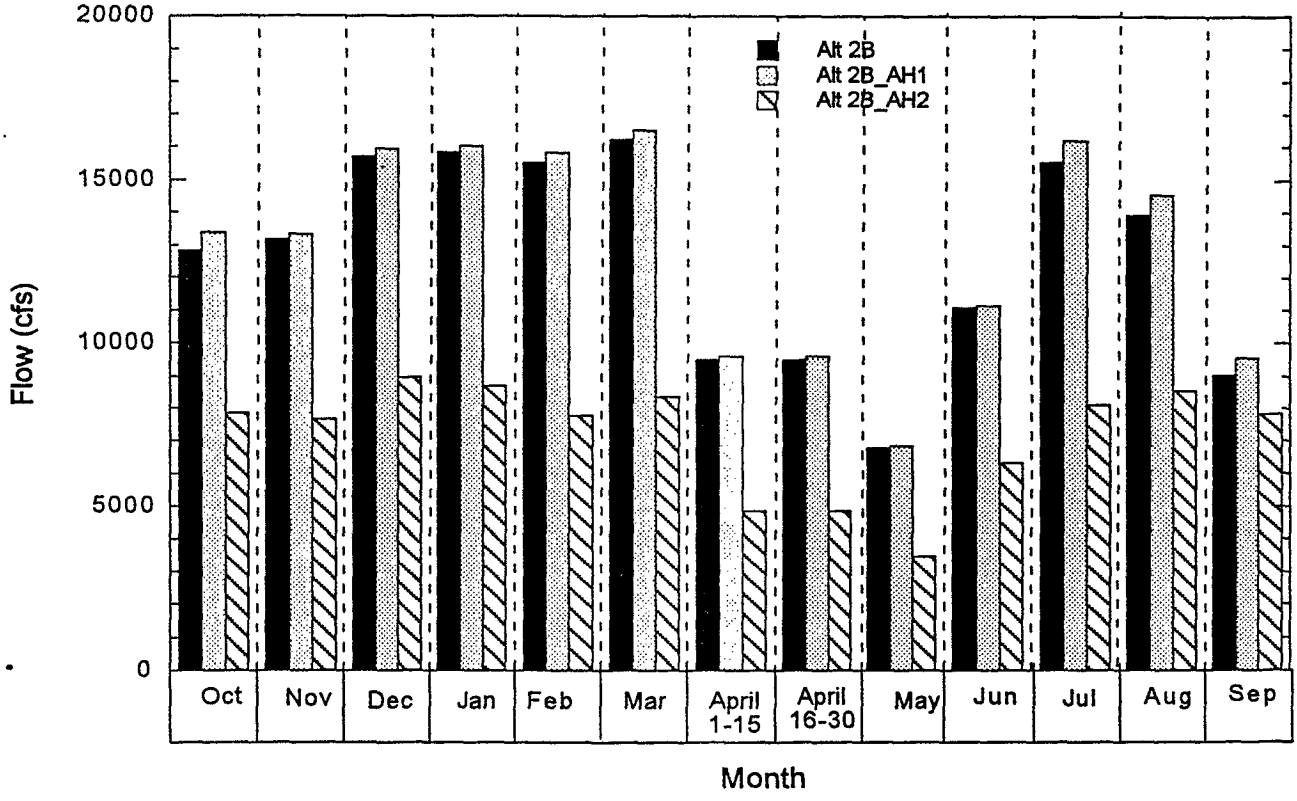


Figure 2: QWEST (Monthly Average Flow)
(comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

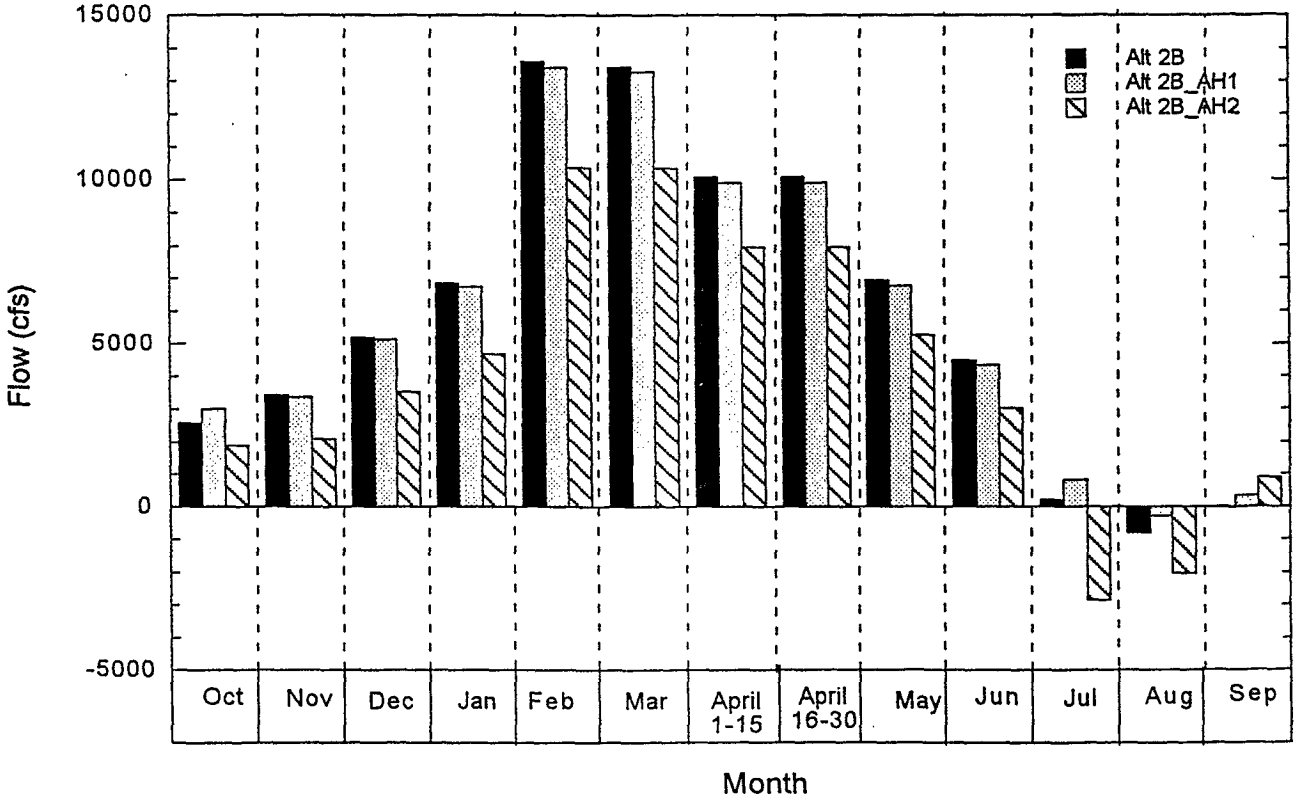


Figure 3: Rio Vista (Monthly Average Flow)
(comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

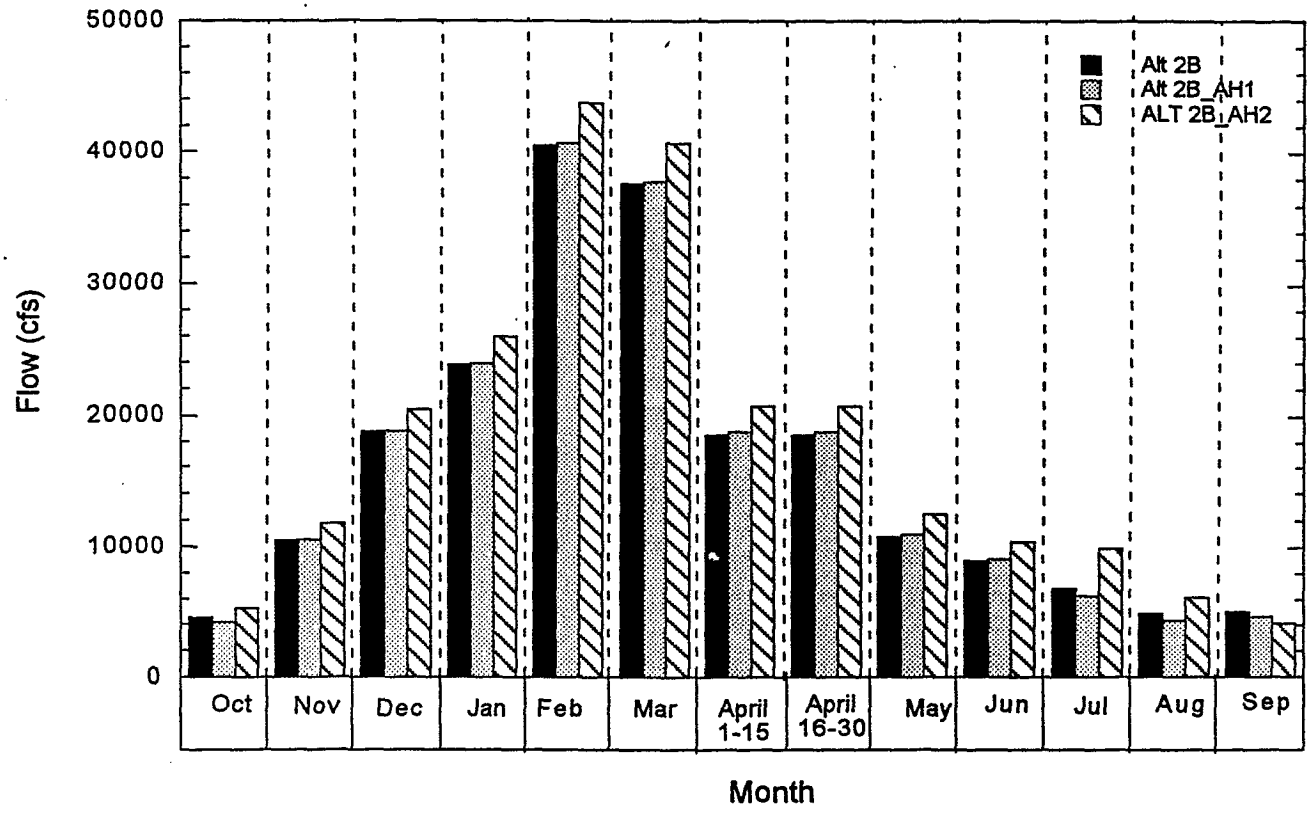


Figure 4: Georgiana Slough (Monthly Average Flow)
(comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

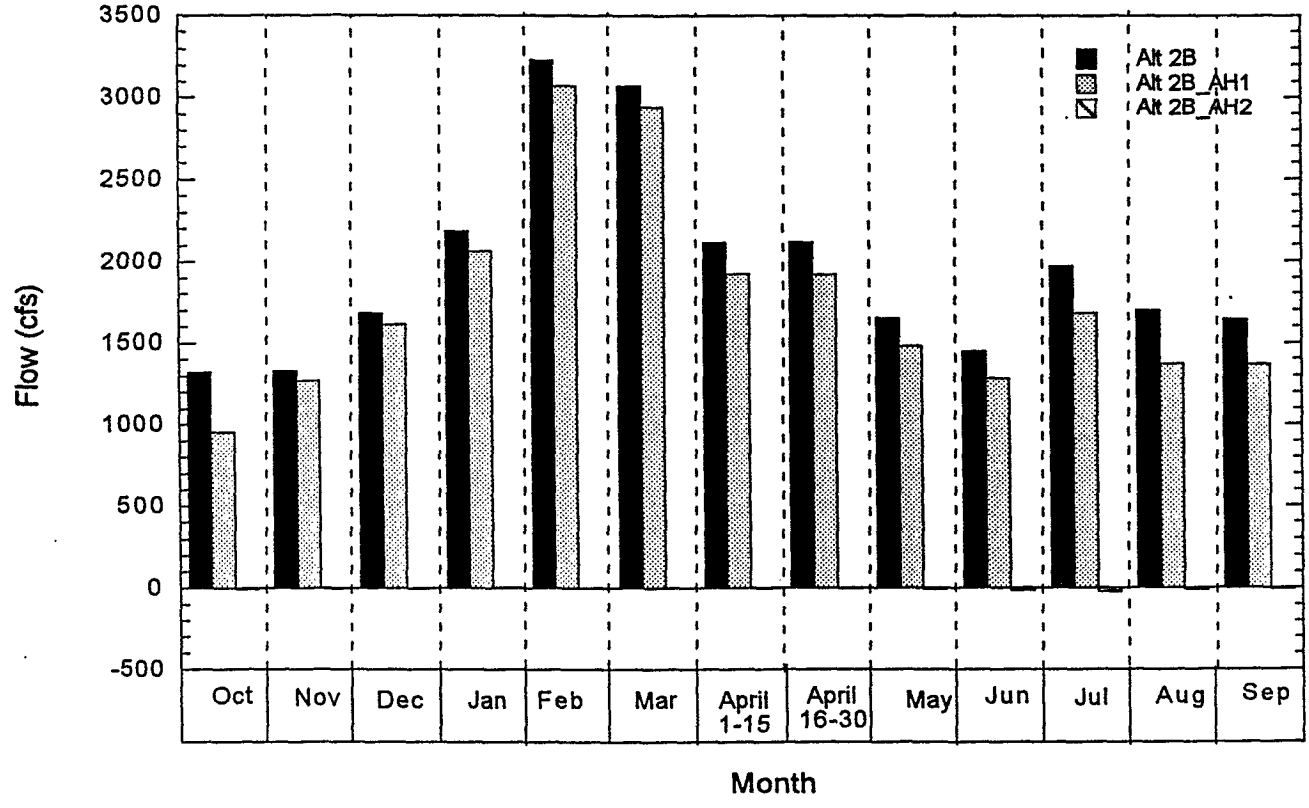


Figure 5: North Fork Mokelumne (Monthly Average Flow) (comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

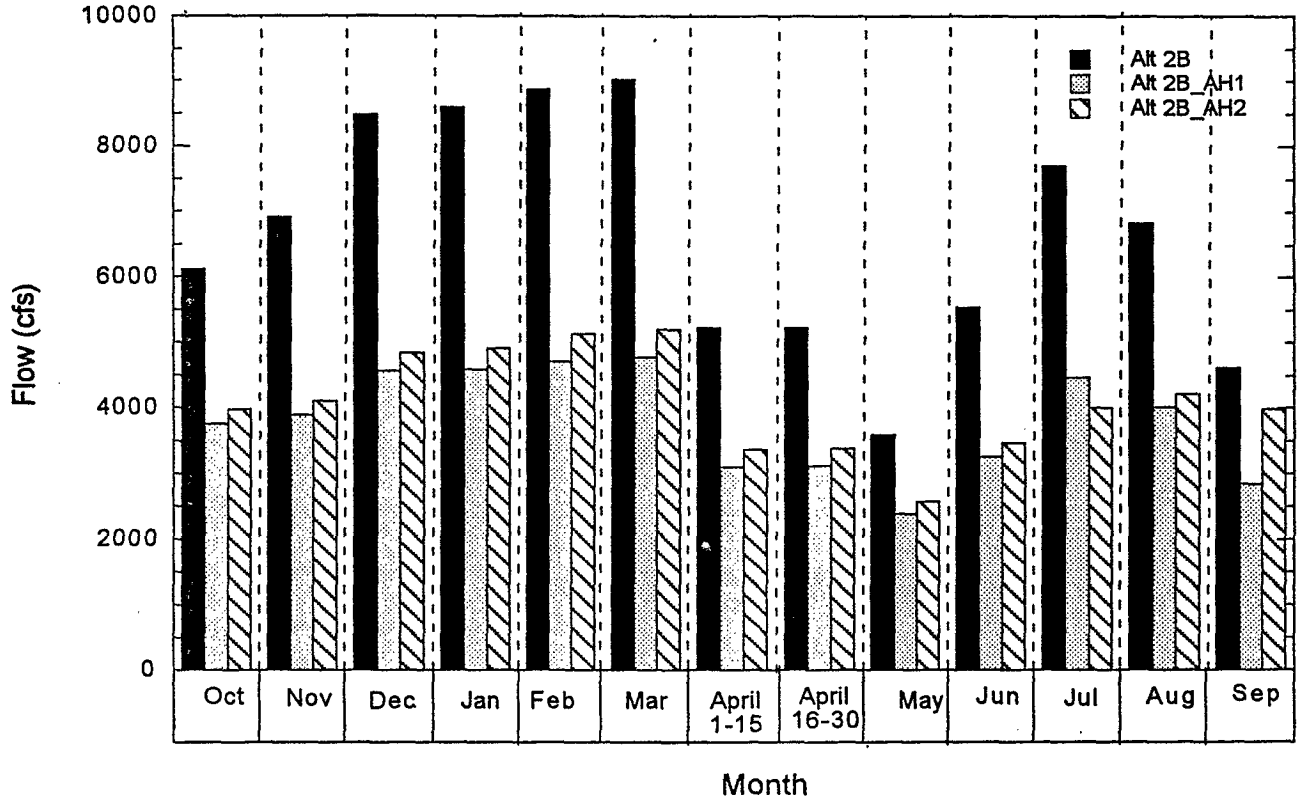


Figure 6: South Fork Mokelumne (Monthly Average Flow) (comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

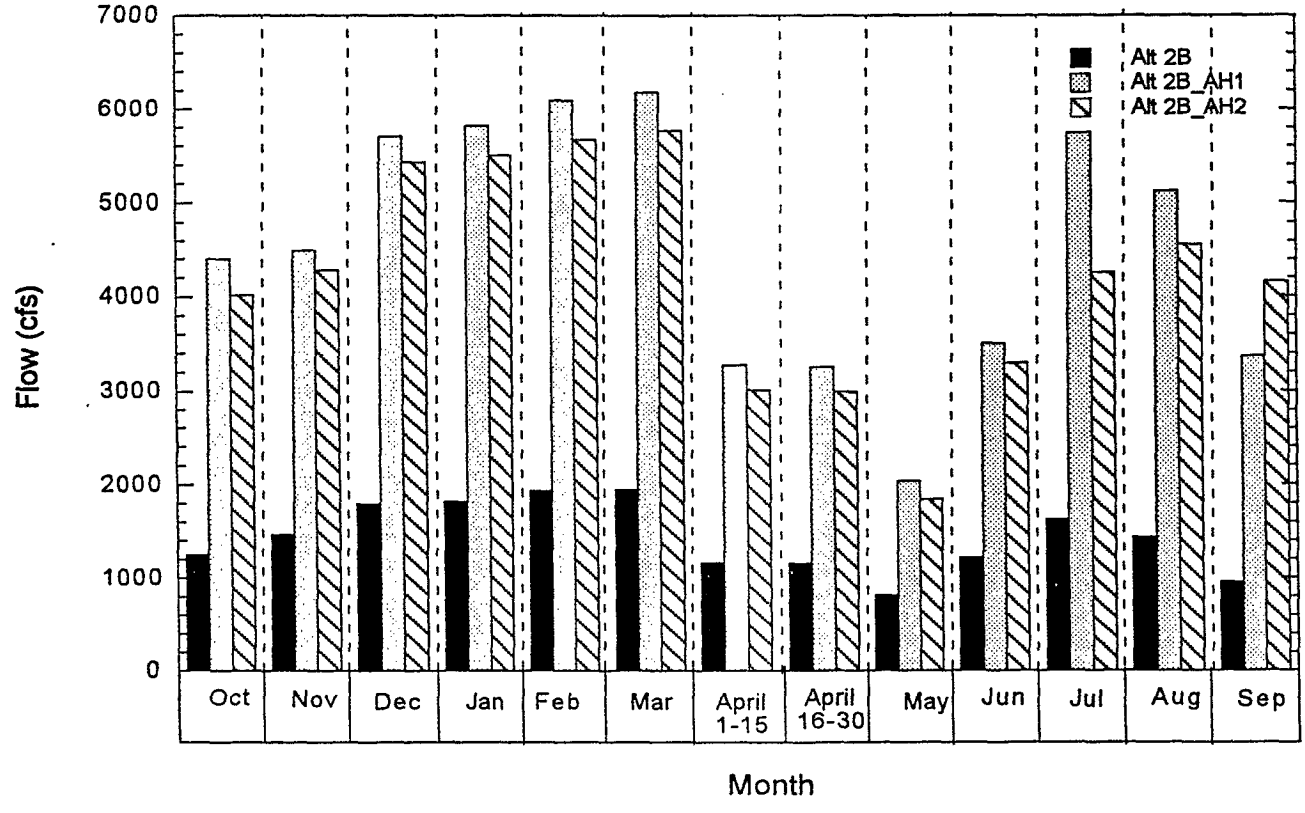


Figure 7: Mokelumne River (Monthly Average Flow)
(comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

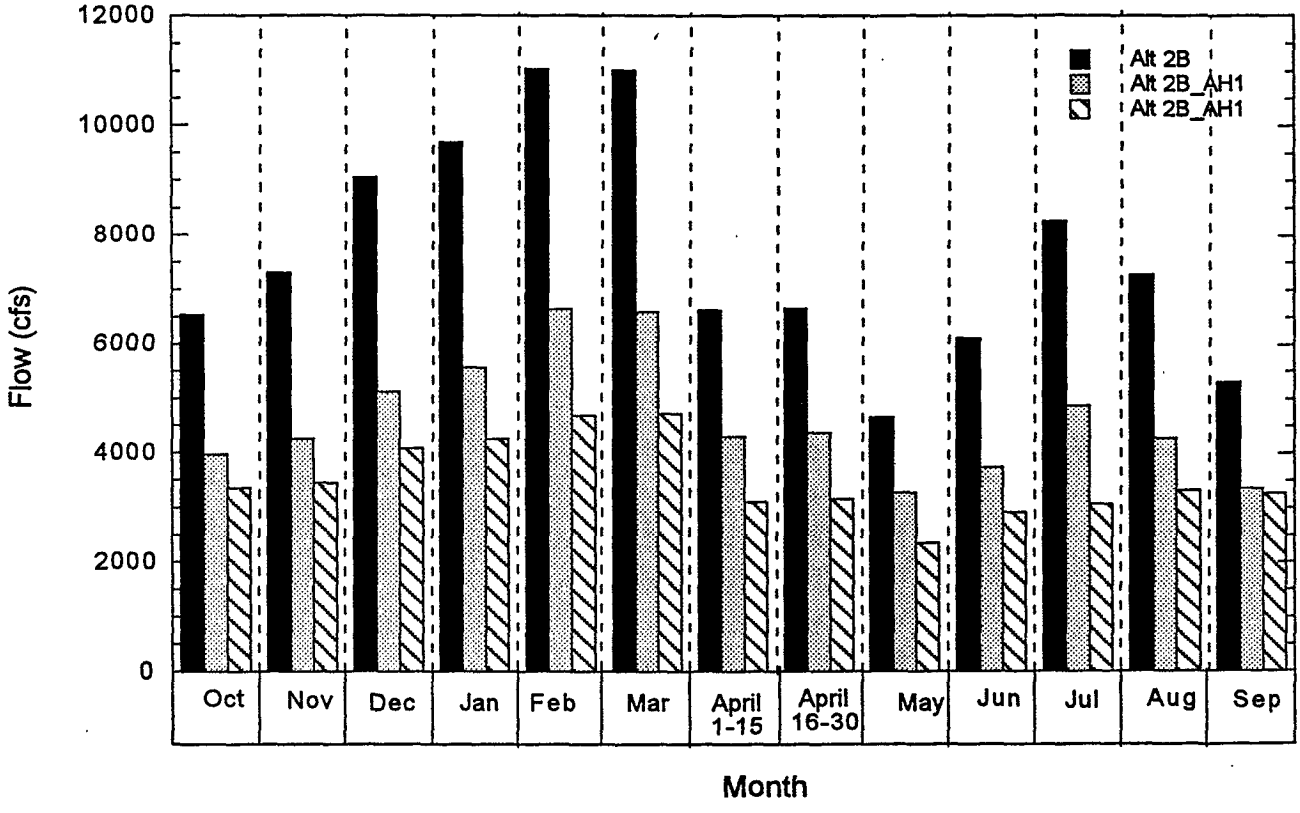
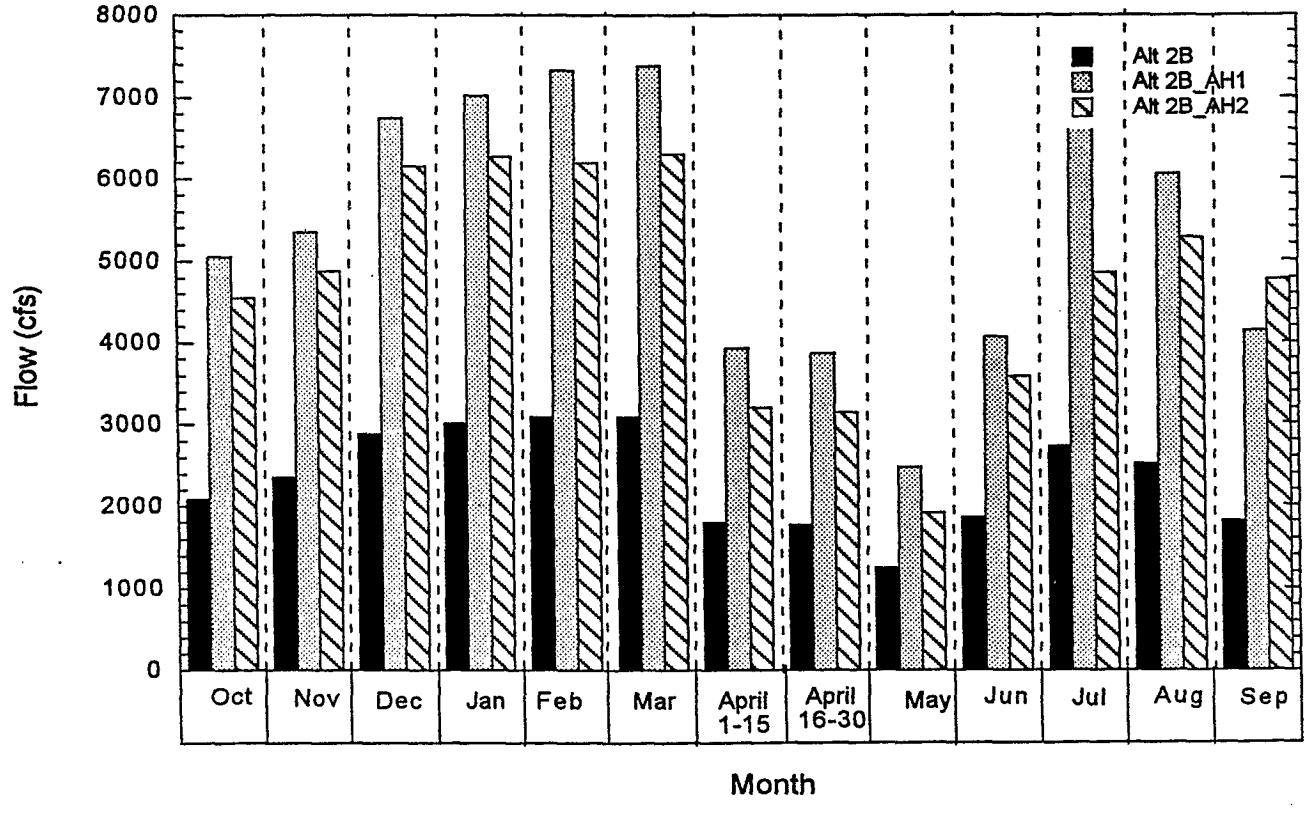


Figure 8: Little Potato Slough (Monthly Average Flow)
(comparison between Alternatives 2B, 2B_AH1, 2B_AH2)



San Joaquin River at Brandt Bridge and Stockton - All three alternatives showed similar flows at these locations (Figures 9 &10).

Jersey Point and Antioch - In both locations Alternative 2B_AH2 gave lower values. Alternatives 2B and 2B_AH1 had similar flows (Figures 11 & 12).

Old River at Tracy and Middle River at Undine Rd - All three alternatives produced similar flow values at these two locations.

Old River and Middle River at Bacon Island - The combined flow towards the pumps for all three alternatives were the same. Alternative 2B yielded slightly higher flows in the Old River and slightly lower flows in the Middle River. Although Mokelumne River (diverted water in Alternative 2B) is close to the Old River, and Columbia Cut (diverted water in Alternatives 2B_AH1 & 2B_AH2) is close to the Middle River, the flow differences between the alternatives are small.

Electrical Conductivity (EC)

The 16 year average of the monthly average electrical conductivity for each alternative is shown at 16 key locations in the Delta (Figures 17-32). The locations for these 16 stations are shown in Map 5.

Rio Vista - The EC values for all three alternatives were similar for all months except for September and October. Lower Rio Vista flow in September for Alternative 2B_AH2 causes increased EC values. Because September EC affects the October EC, the three alternatives produced different EC values for these months (Figure 17).

Emmaton - Very similar to Rio Vista. More pronounced tidal action tends to dwarf the difference in inflows for the month of September (Figure 18).

San Joaquin River at Brandt Bridge - All three alternatives gave similar EC results. Geometry change in the North Delta has no bearing in the EC at Brandt Bridge (Figure 19).

San Joaquin River at Ringe Tract - Proximity to Columbia Cut (diverted water enters SJR) produces lower EC values for Alternatives 2B_AH1 and 2B_AH2. At this location, EC for Alternative 2B_AH1 is better than Alternative 2B_AH2. Higher Cross Delta flow for Alternative 2B_AH1 could be attributed for this phenomenon (Figure 20).

San Joaquin River at Prisoners Point, San Andreas Landing and Jersey Point - The EC values for Alternative 2B_AH2 is higher at these locations compared to the other two alternatives (Figures 21 & 22). The Cross Delta Flow effects the EC at these locations. The combined Flow are similar for the Alternatives 2B and 2B_AH1 and lower for Alternative 2B_AH2 (see Figures 1).

Figure 9: SJR at Brandt Bridge (Monthly Average Flow)
(comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

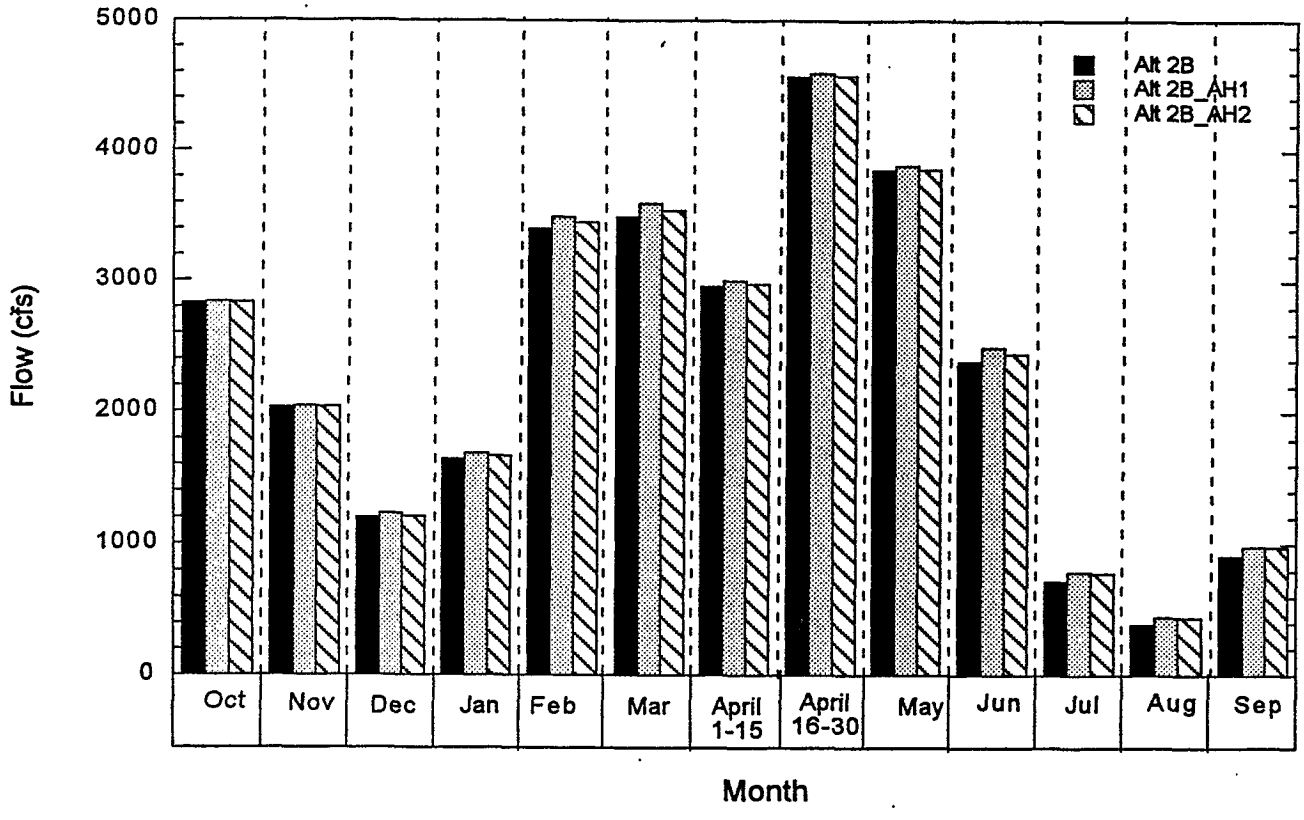


Figure 10: SJR near Stockton (Monthly Average Flow)
(comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

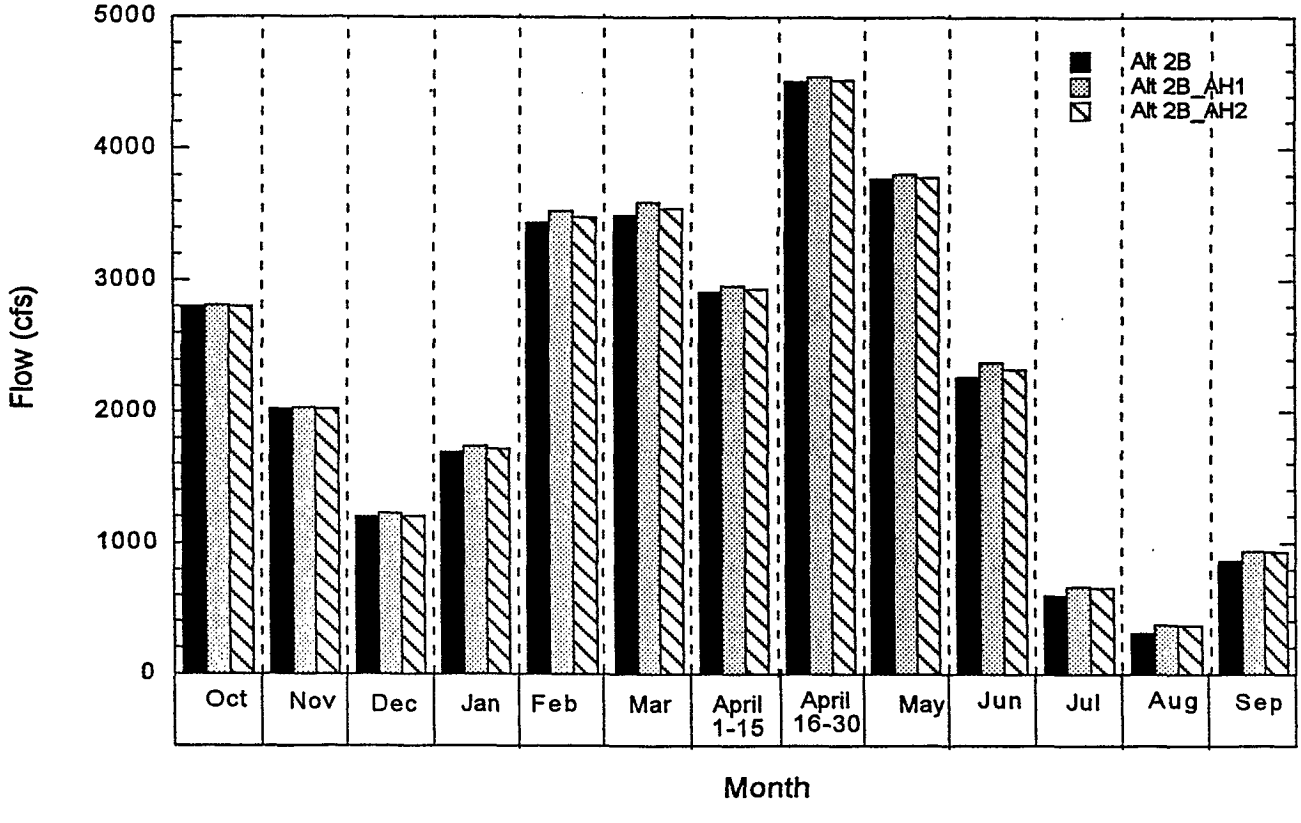


Figure 11: Jersey Point (Monthly Average Flow)
(comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

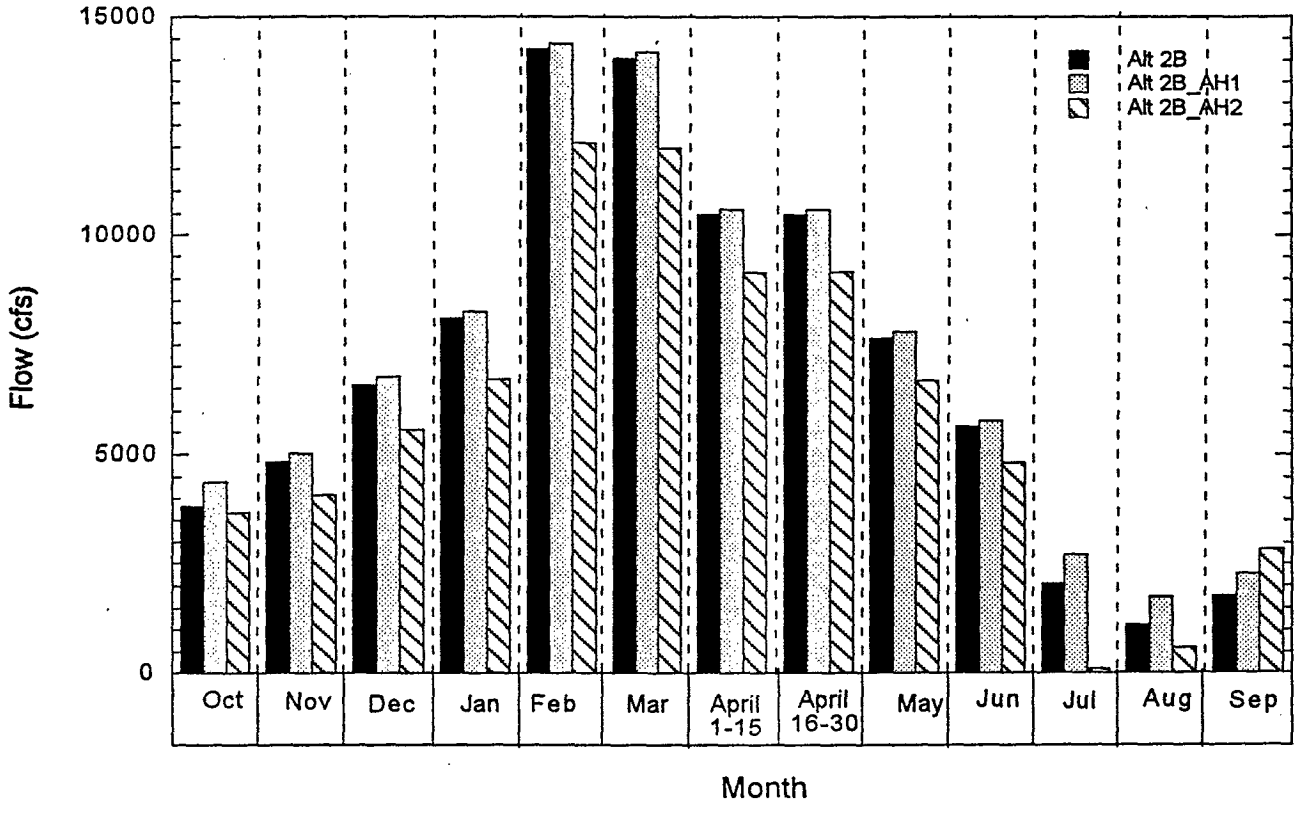


Figure 12: Antioch (Monthly Average Flow)
(comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

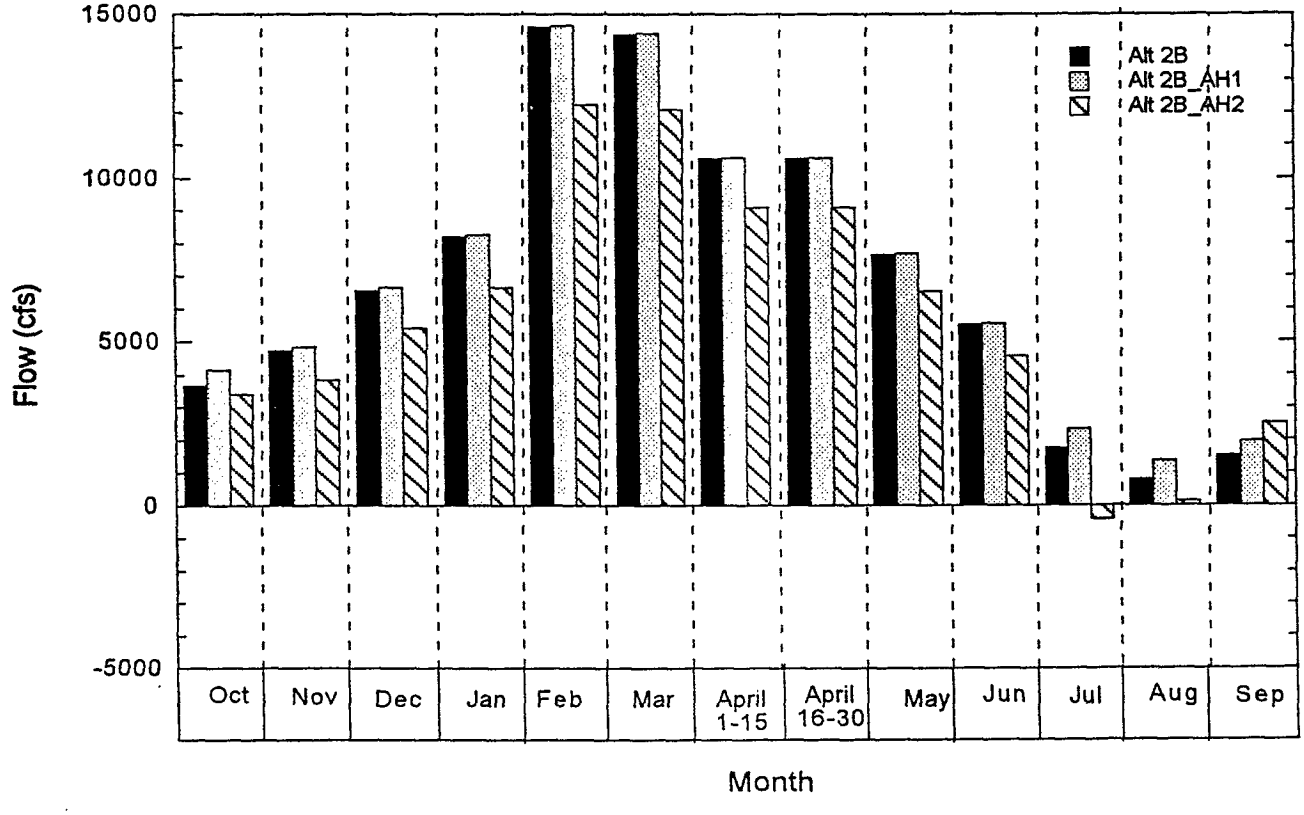


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Figure 13: Old River at Tracy (Monthly Average Flow)
(comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

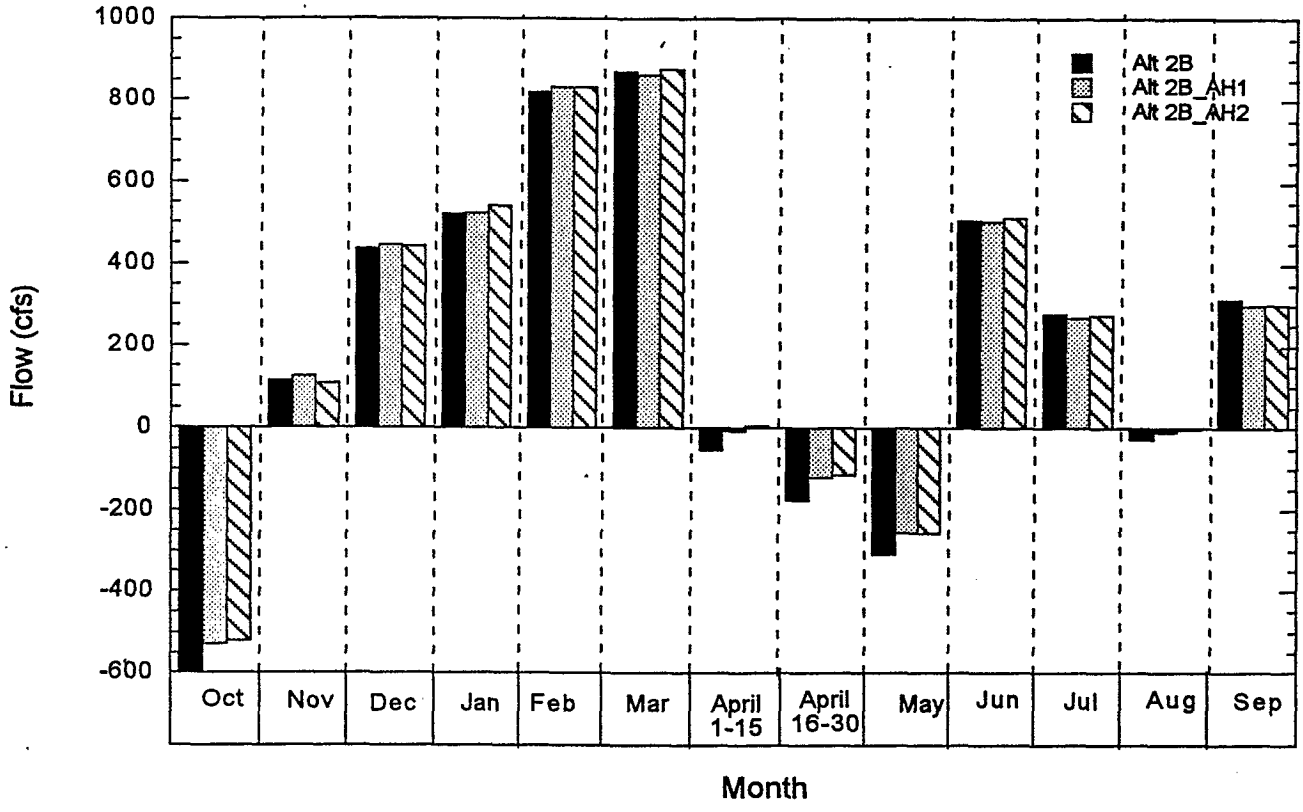


Figure 14: Middle River at Undine Rd. (Monthly Average Flow)
(comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

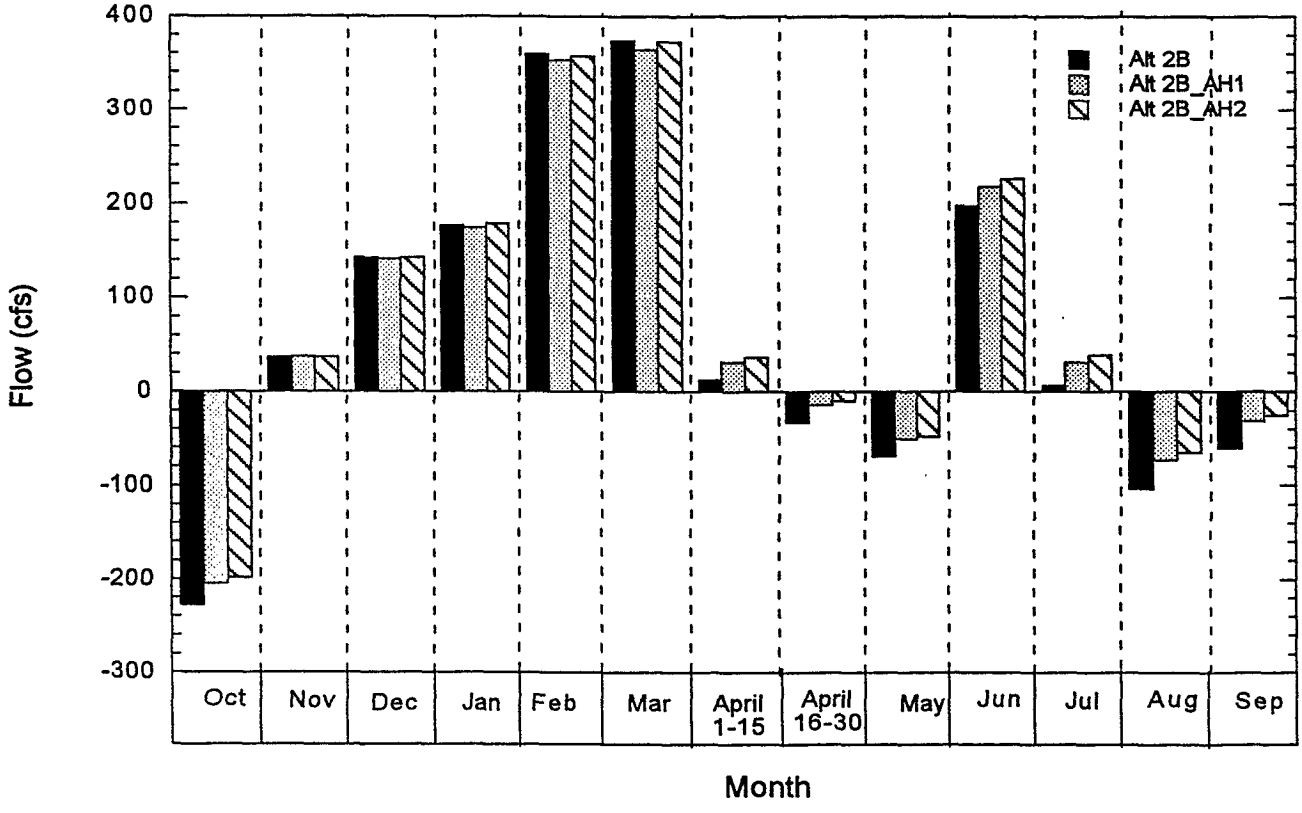


Figure 15: Old River at Bacon Is. (Monthly Average Flow)
(comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

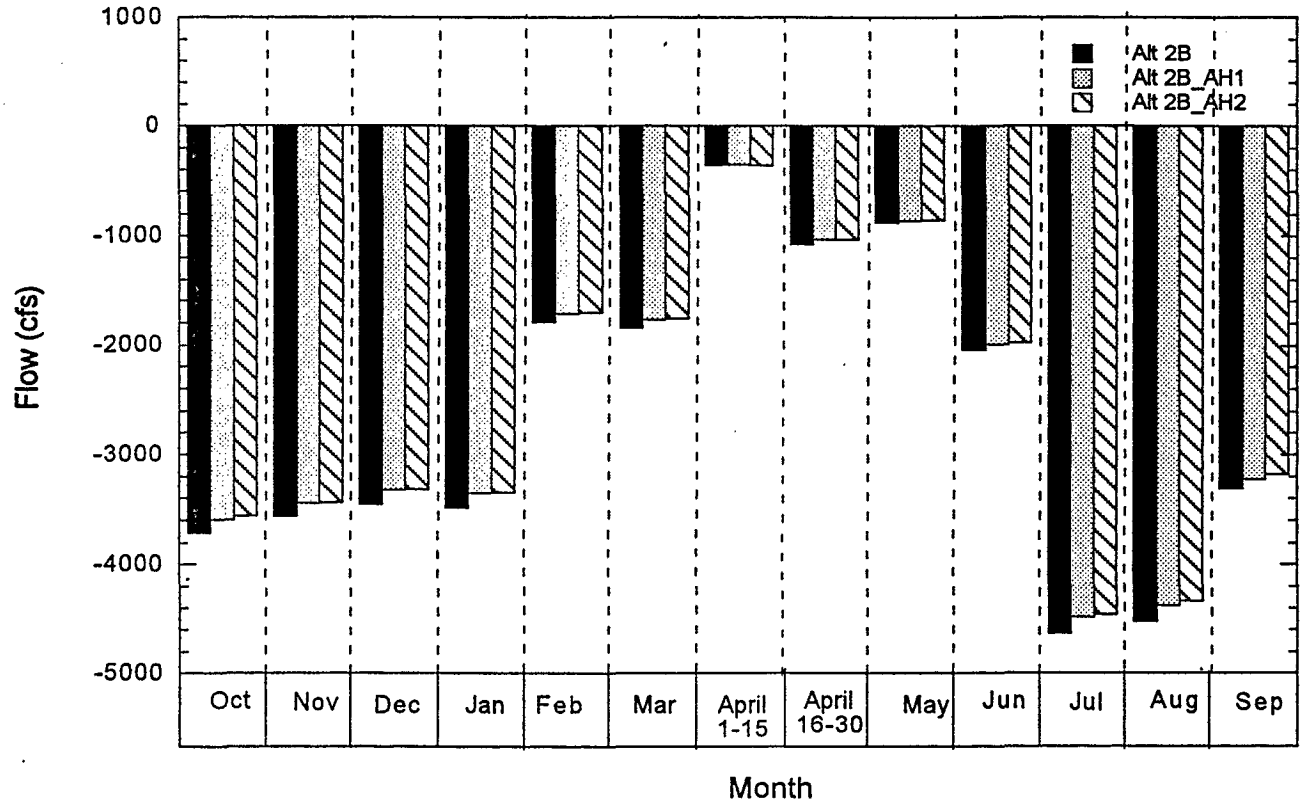
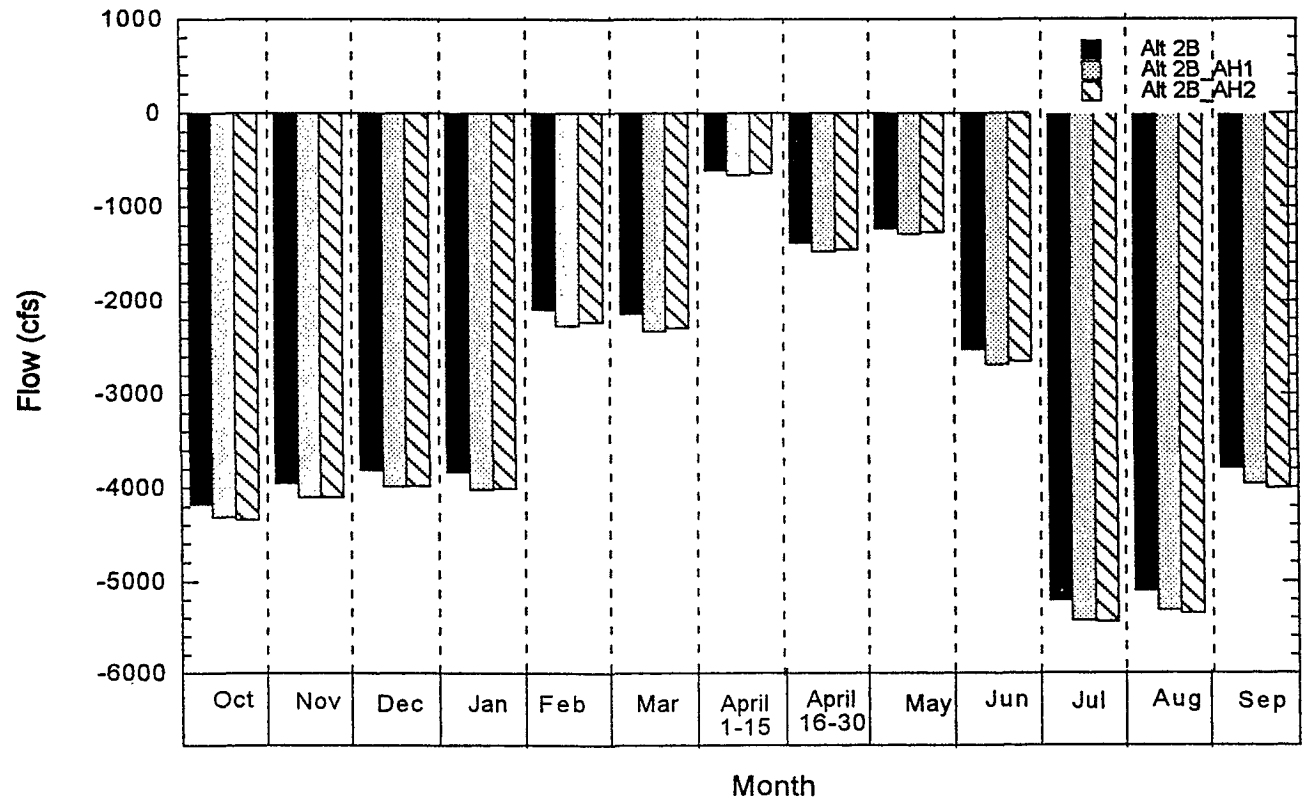
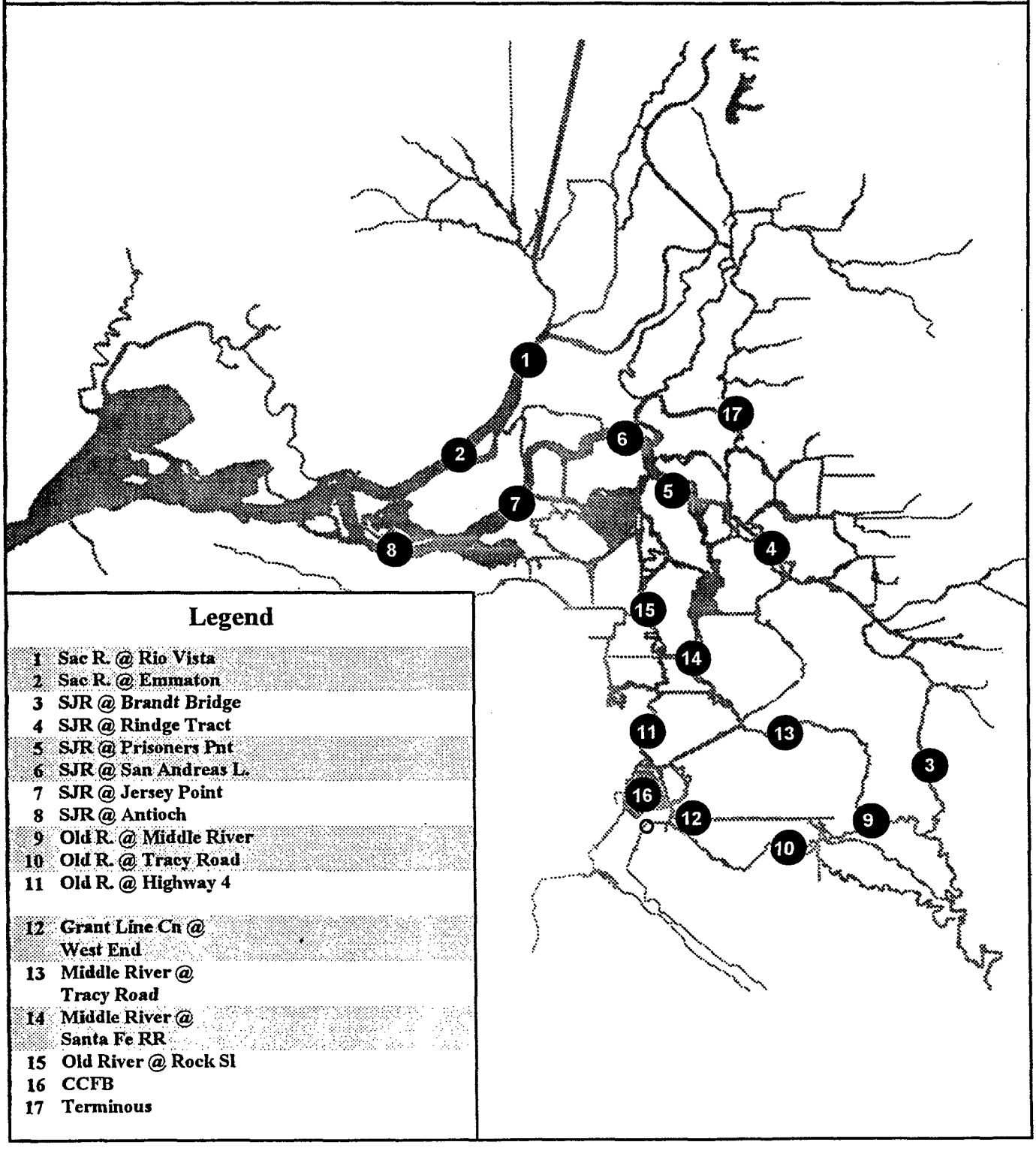


Figure 16: Middle River at Bacon Is. (Monthly Average Flow)
(comparison between Alternatives 2B, 2B_AH1, 2B_AH2)



Map 5

Output Locations for Monthly Average Electrical Conductivity



Legend

1	Sac R. @ Rio Vista
2	Sac R. @ Emmaton
3	SJR @ Brandt Bridge
4	SJR @ Rindge Tract
5	SJR @ Prisoners Pnt
6	SJR @ San Andreas L.
7	SJR @ Jersey Point
8	SJR @ Antioch
9	Old R. @ Middle River
10	Old R. @ Tracy Road
11	Old R. @ Highway 4
12	Grant Line Cn @ West End
13	Middle River @ Tracy Road
14	Middle River @ Santa Fe RR
15	Old River @ Rock Sl
16	CCFB
17	Terminous

Figure 17: Sacramento River at Rio Vista (Monthly Average EC)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

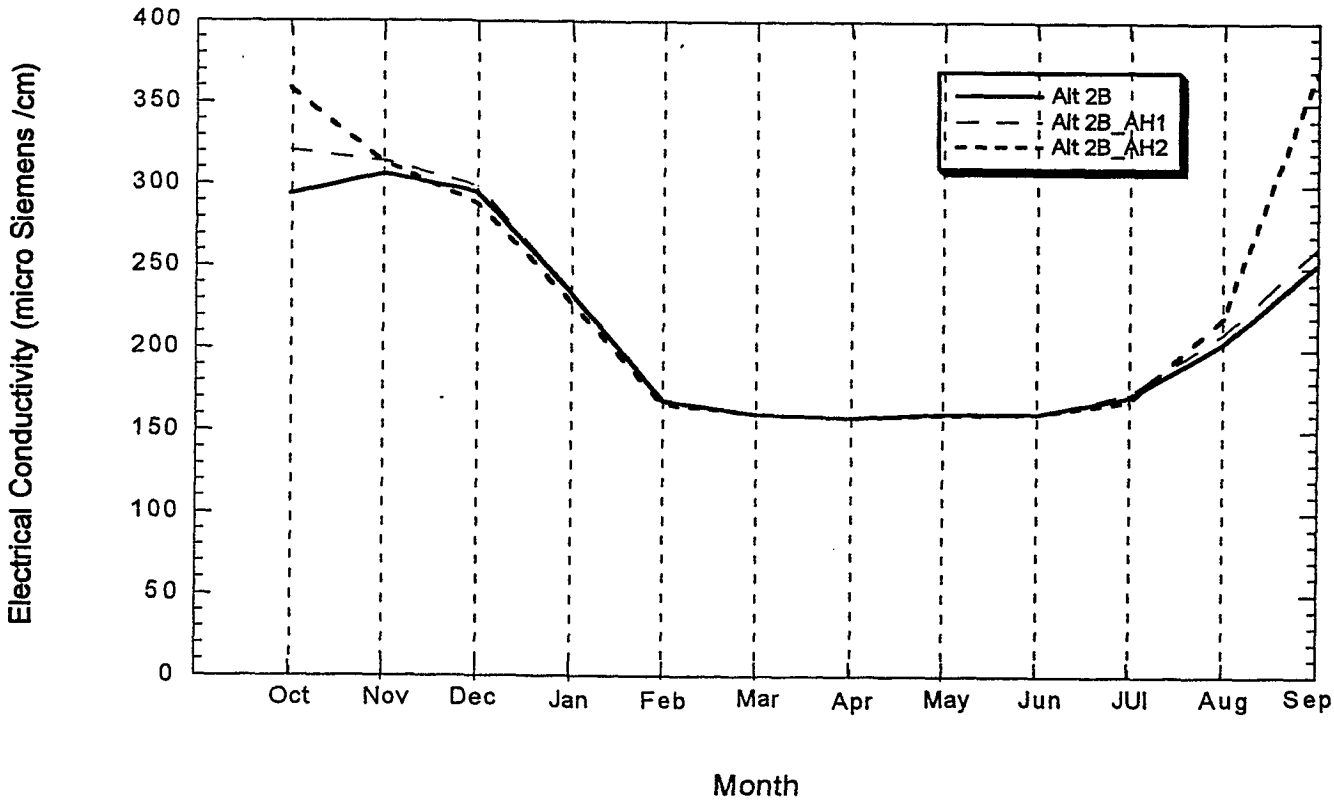


Figure 18: Sacramento River at Emmaton (Monthly Average EC)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

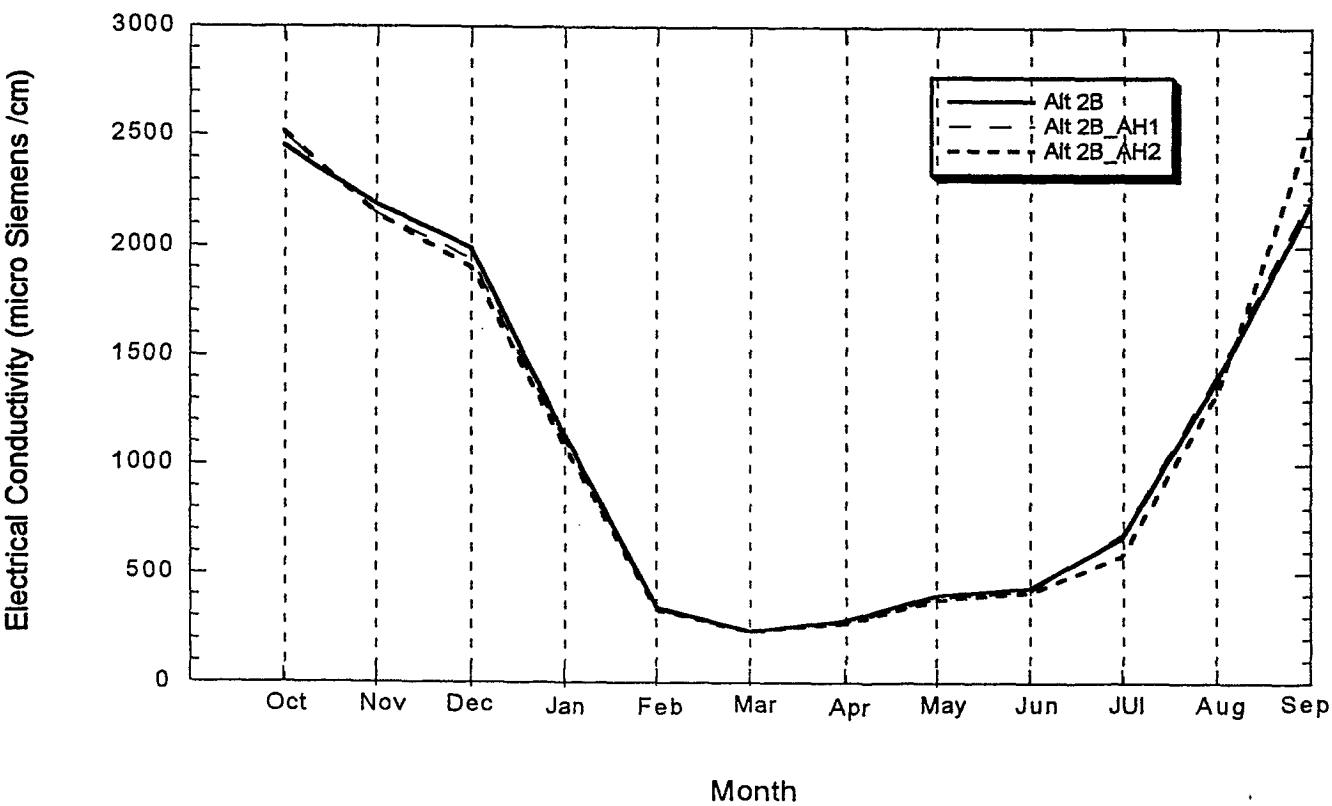


Figure 19: San Joaquin River at Brandt Bridge (Monthly Average EC)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

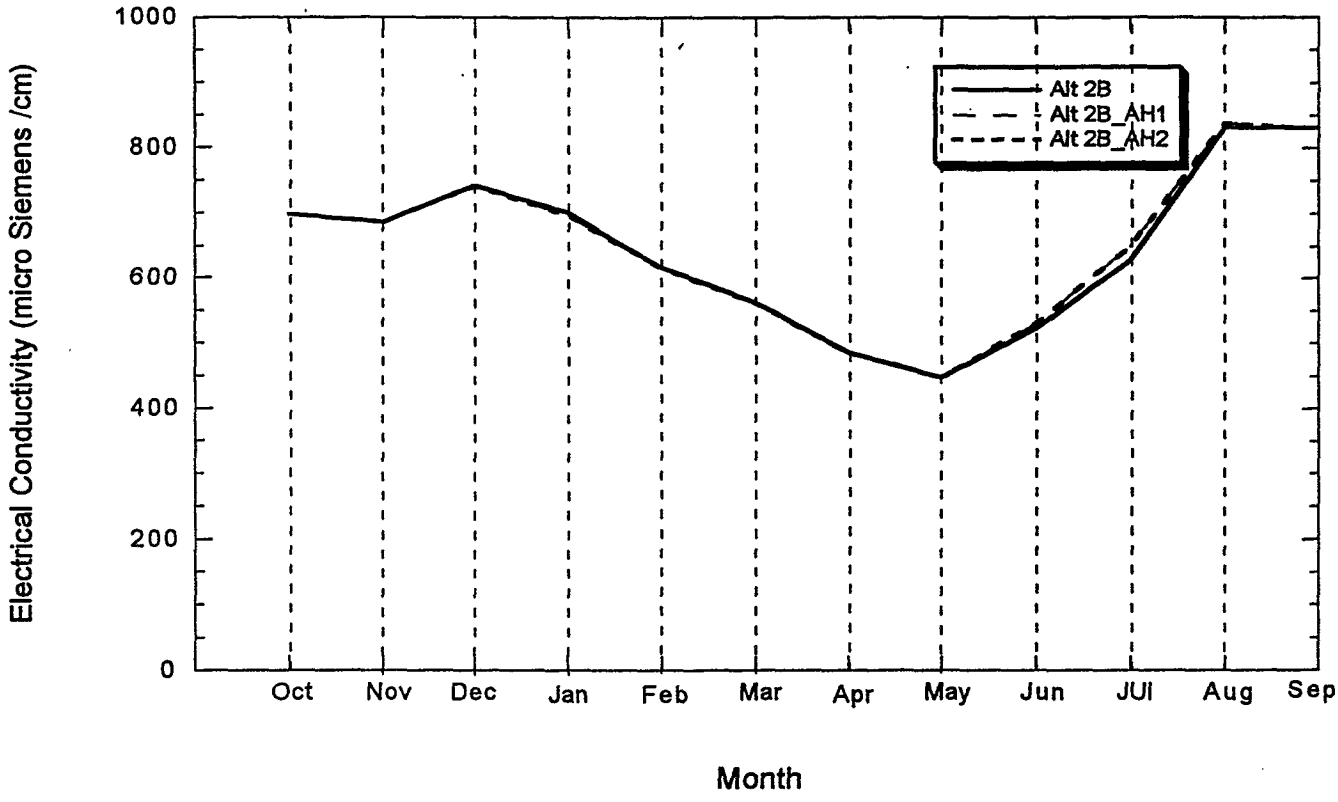


Figure 20: San Joaquin River near Ringe Tract (Monthly Average EC)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

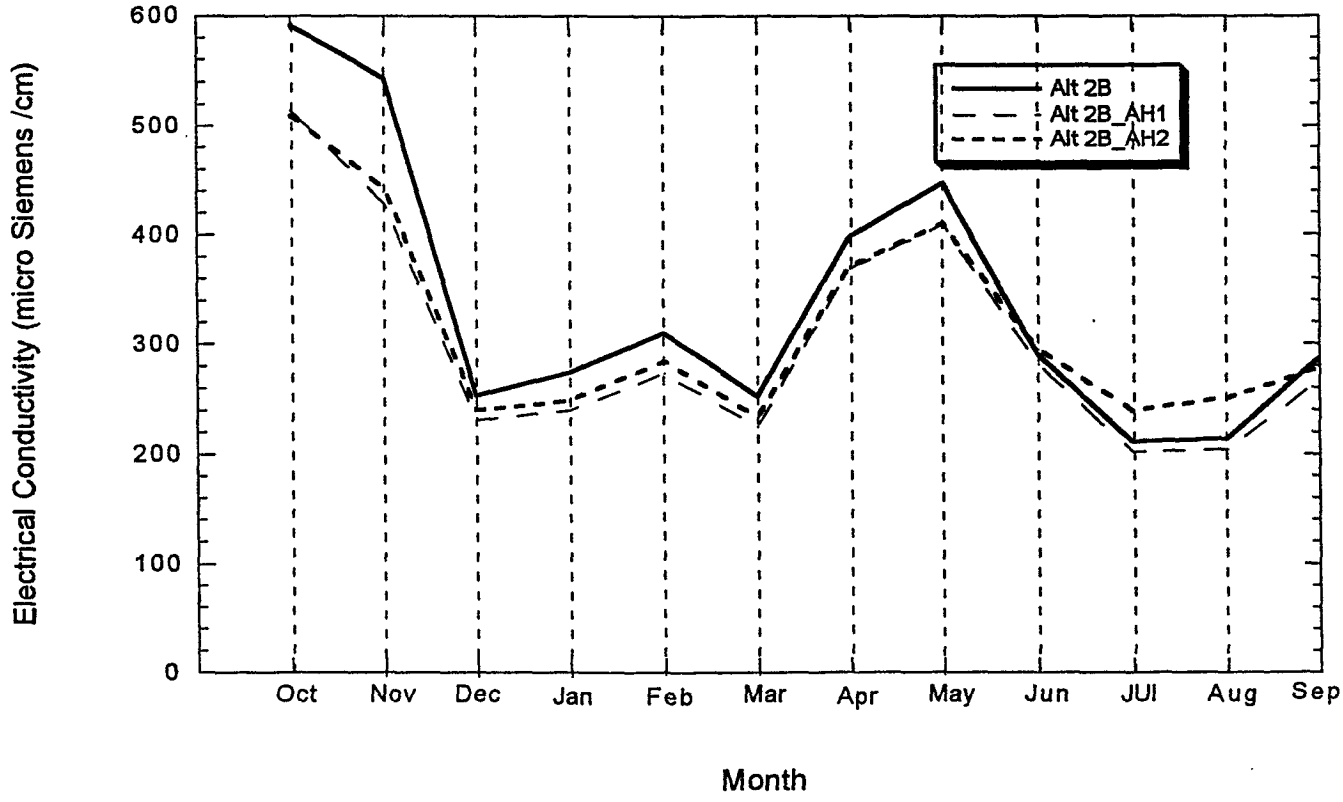


Figure 21: San Joaquin River at Prisoners Point (Monthly Average EC)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

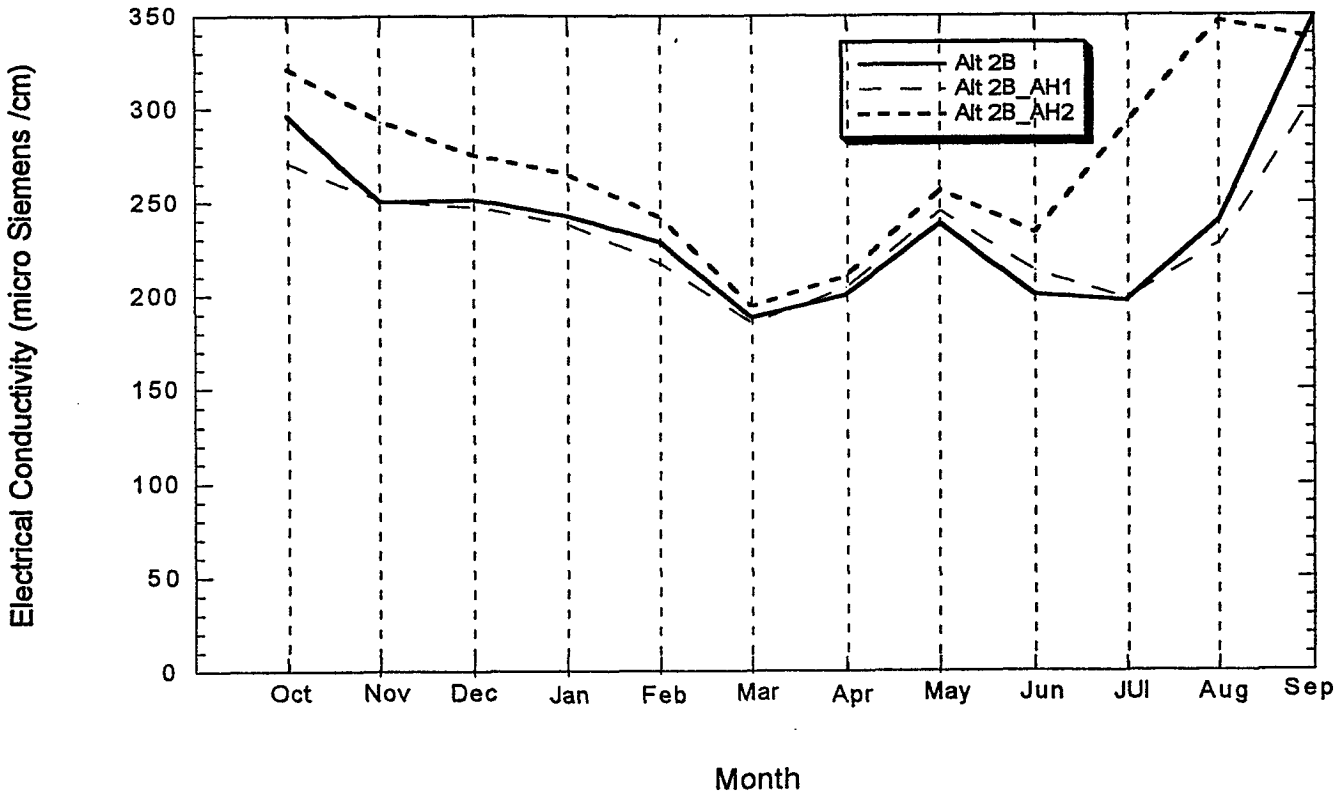
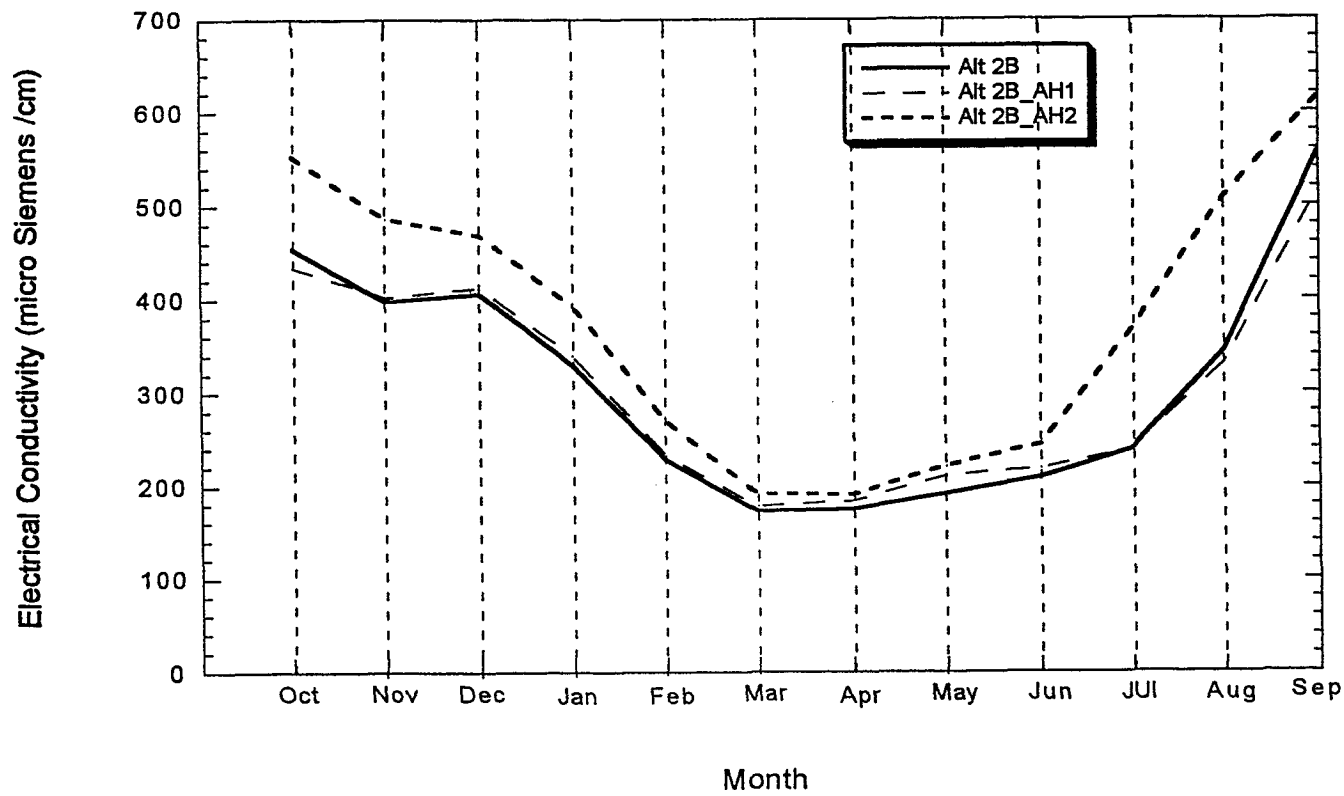


Figure 22: San Joaquin River at San Andreas Landing (Monthly Average EC)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)



San Joaquin River at Antioch - The tidal action overrides any geometry modifications in the North Delta (Figure 24).

Old River at Middle River and at Tracy - Except for minor variations all three alternatives produced the same EC at these two locations (Figures 25 & 26).

Old River at Highway 4 - Except for late winter and early spring Alternative 2B_AH2 had higher EC values than the other two alternatives (Figure 27). Qwest effects the EC at this location. During the late winter and spring months high Qwest values are observed (Figure 2). Even though Alternative 2B_AH2 had a lower Qwest among the alternatives, the flow was high enough to push the ocean salt away from the Delta effectively as the other two alternatives. However in summer and fall, when the Qwest values are low, the Qwest of Alternative 2B_AH2 is low enough to show a difference in EC at this location.

Grant Line Canal, West End - No change in EC values for the three alternatives (Figure 28).

Middle River at Tracy Road - The direction of flow in Middle River changes for different months (Figure 14). With each change in flow direction the EC values at this location fluctuates. The EC values for the three alternatives changes respect to one another with time (Figure 29).

Middle River at Santa Fe Rail Road - Alternative 2B had lower flow in the Middle River at Bacon Island (Figure 16). Therefore higher EC values are obtained for Alternative 2B than the other two alternatives. The high EC value in May can be attributed to low flows along Middle River in April and May (Figure 30).

Old River at Rock Slough - Similar to Old River at Highway 4 (Figure 31).

Clifton Court Forebay - Similar EC profiles to Rock Slough. Because San Joaquin water quality influences the EC at CCFB more than at Rock Slough the EC differences between the alternatives are lower (Figure 32).

Terminous - With improvements to South Fork of Mokelumne, more Sacramento water passes through Terminous (Figure 8). Therefore EC values of Alternatives 2B_AH1 and 2B_AH2 should be lower than Alternative 2B. However between May and August high monthly average EC values are noticed in Alternative 2B_AH2(Figure 32a). Reason for this phenomena is that EC on very dry years (1977 & 1990) influence the average EC. On these 2 years very little water passes through Terminous when both Delta Cross Channel and Georgiana Slough are closed, resulting in very high EC values. For the rest of the period (except 1977 and 1990) the EC values at Terminous for Alternative 2B_AH2 are lower than Alternative 2B.

Figure 23: San Joaquin River at Jersey Point (Monthly Average EC)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

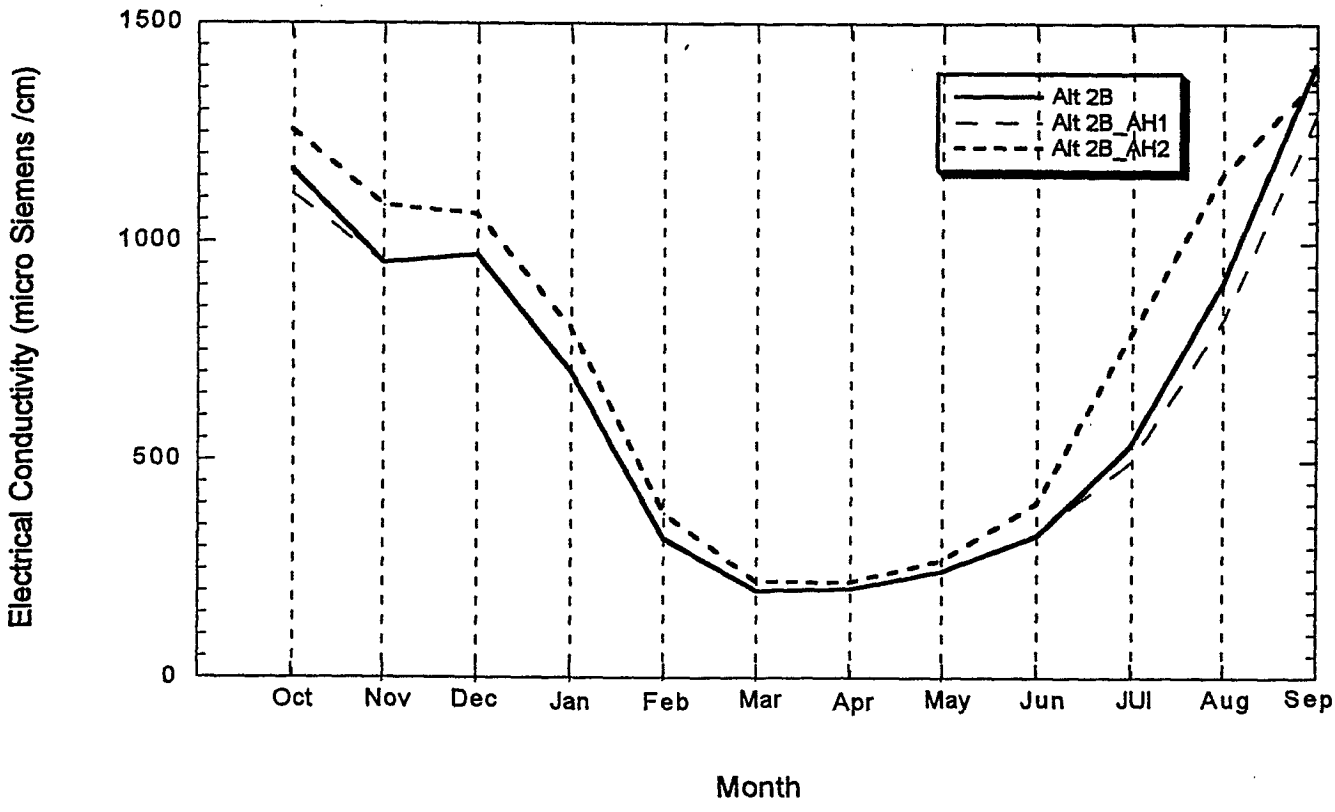


Figure 24: San Joaquin River at Antioch (Monthly Average EC)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

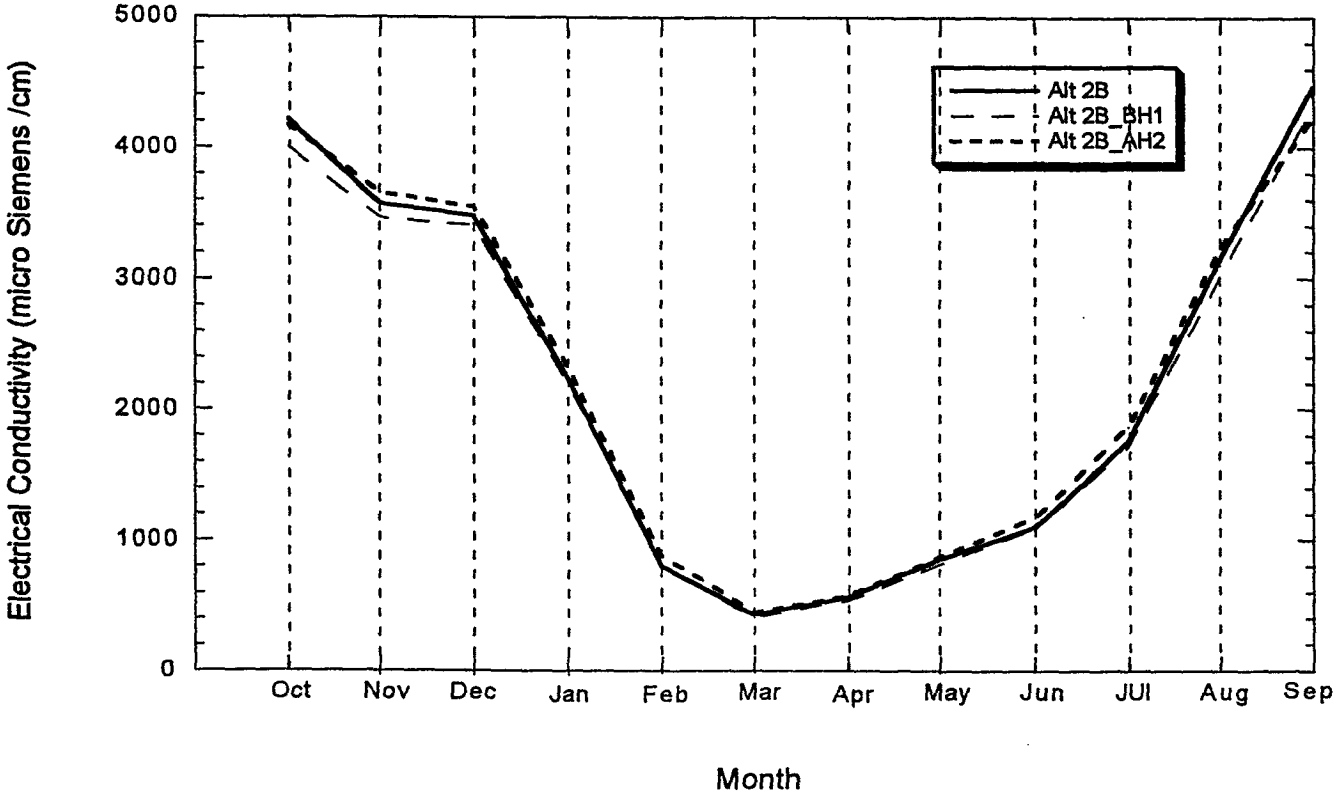


Figure 25: Old River at Middle River (Monthly Average EC)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

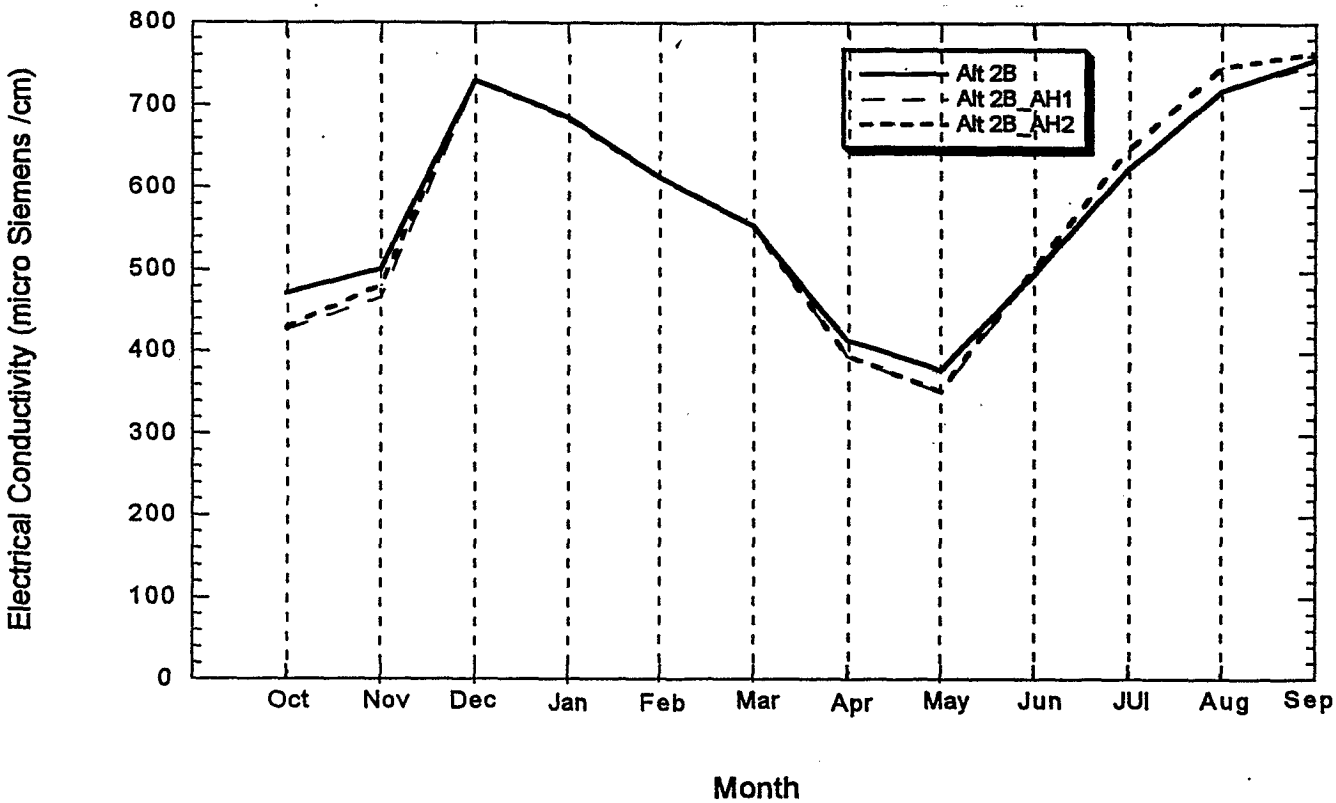


Figure 26: Old River at Tracy (Monthly Average EC)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

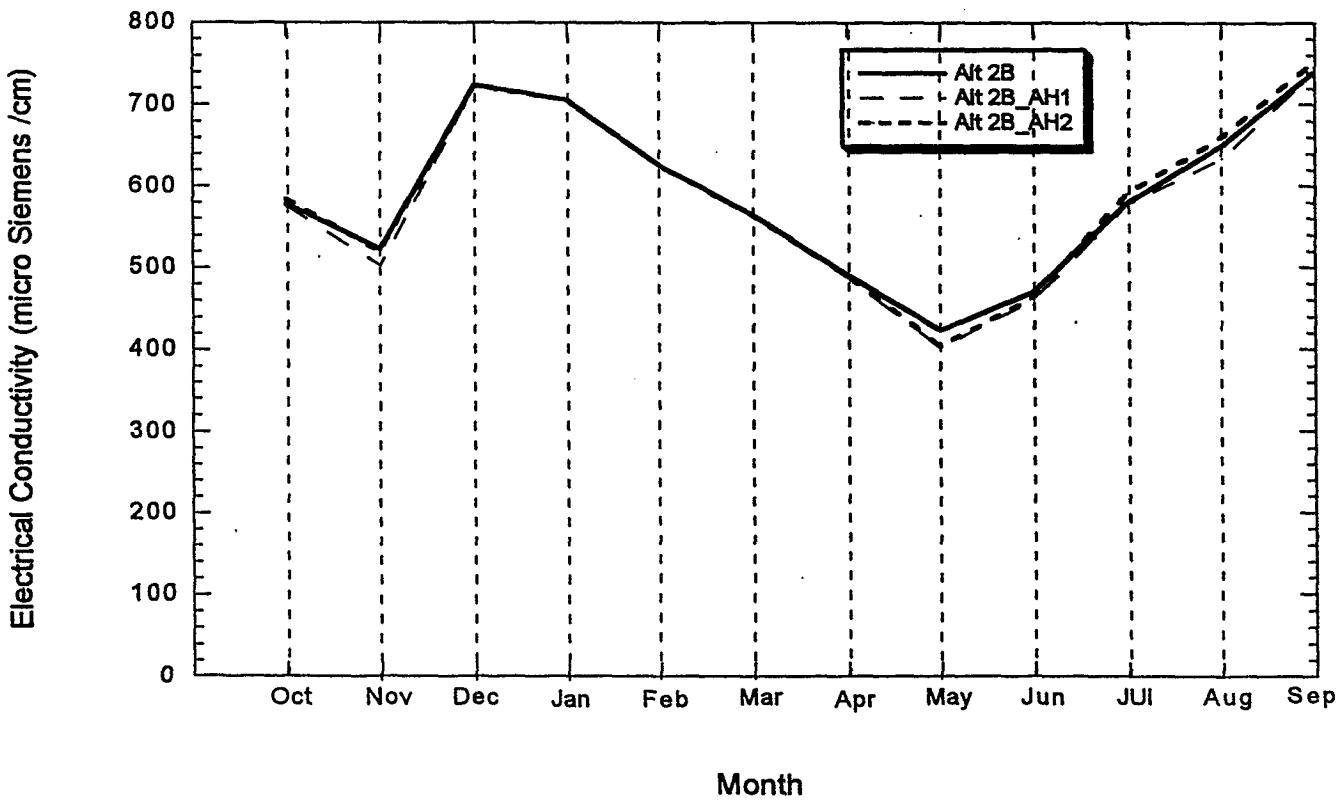


Figure 27: Old River at Highway 4 (Monthly Average EC)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

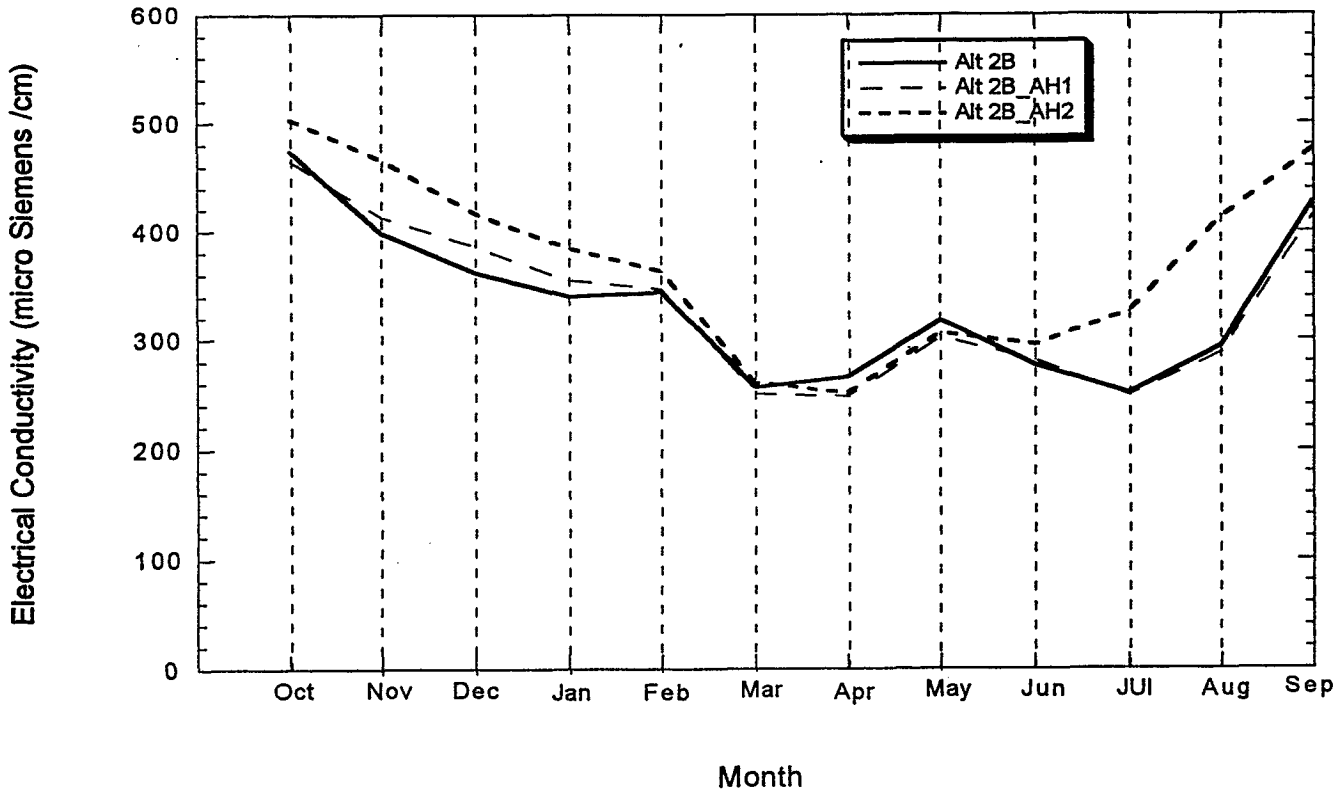


Figure 28: Grant Line Canal - West End (Monthly Average EC)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

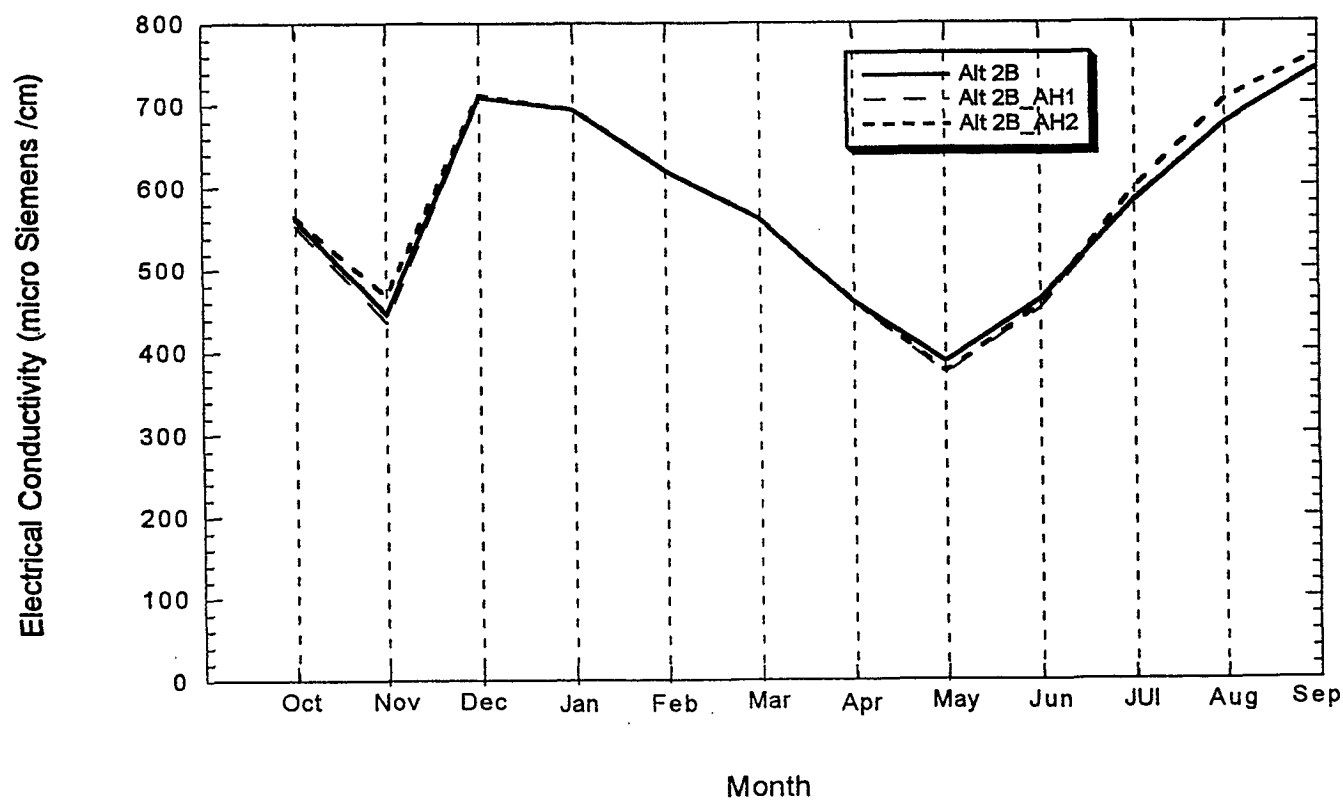


Figure 29: Middle River at Tracy Road (Monthly Average EC)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

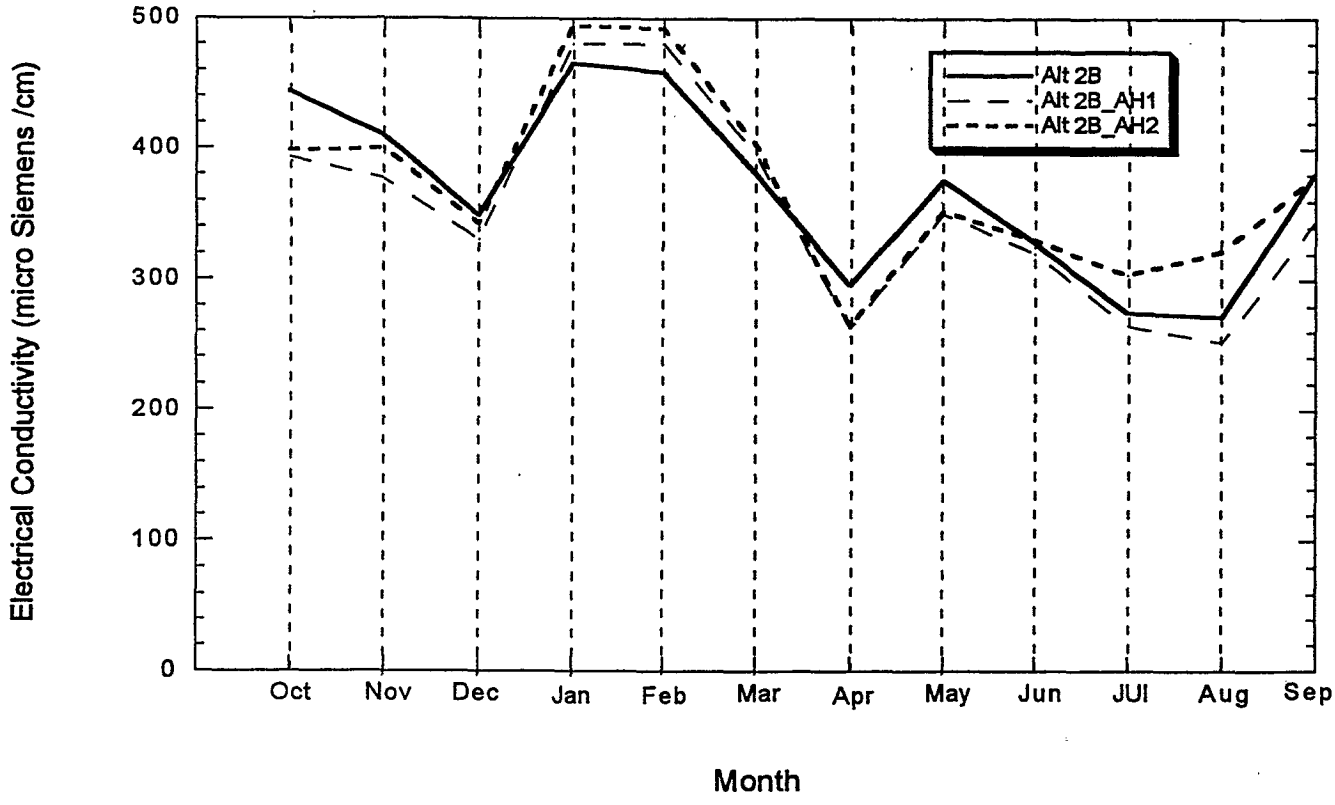


Figure 30: Middle River at Santa Fe RR. (Monthly Average EC)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

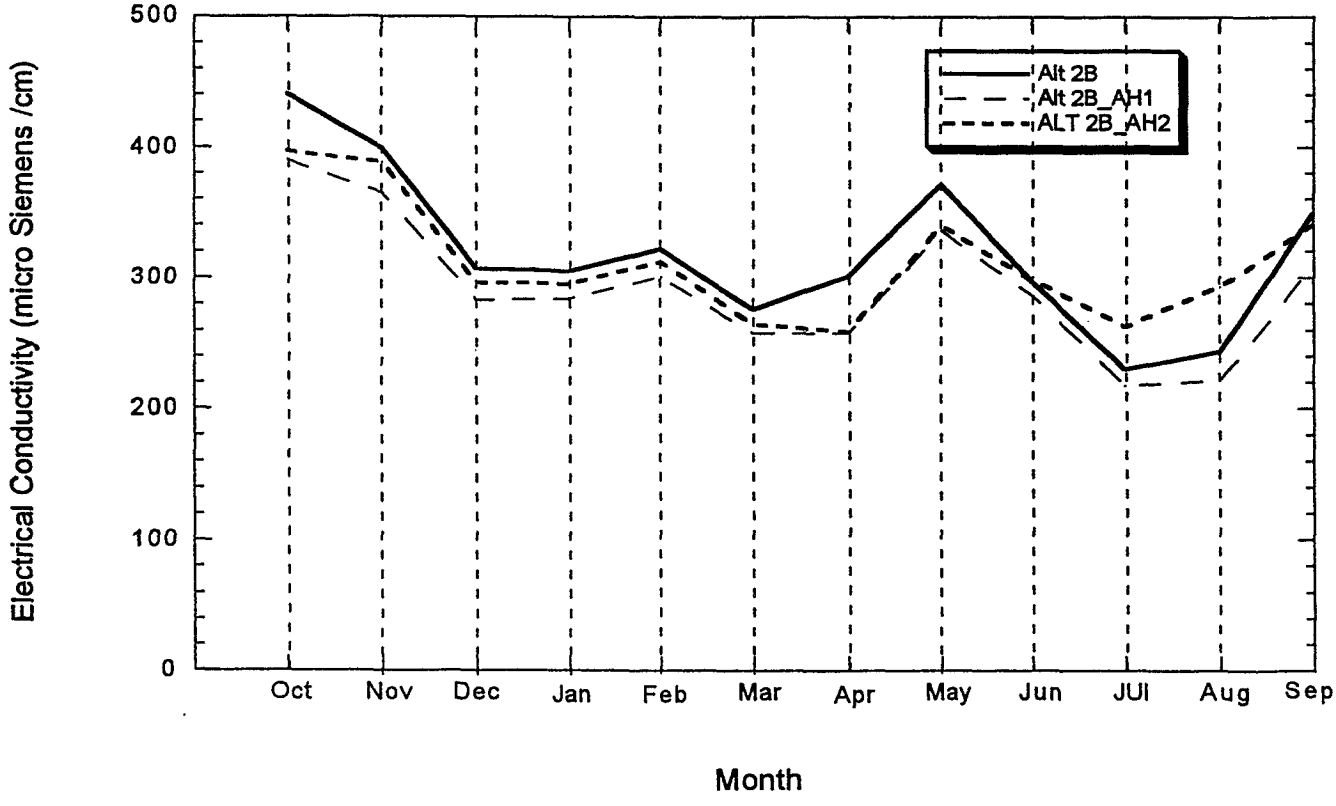


Figure 31: Old River at Rock Slough (Monthly Average EC)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

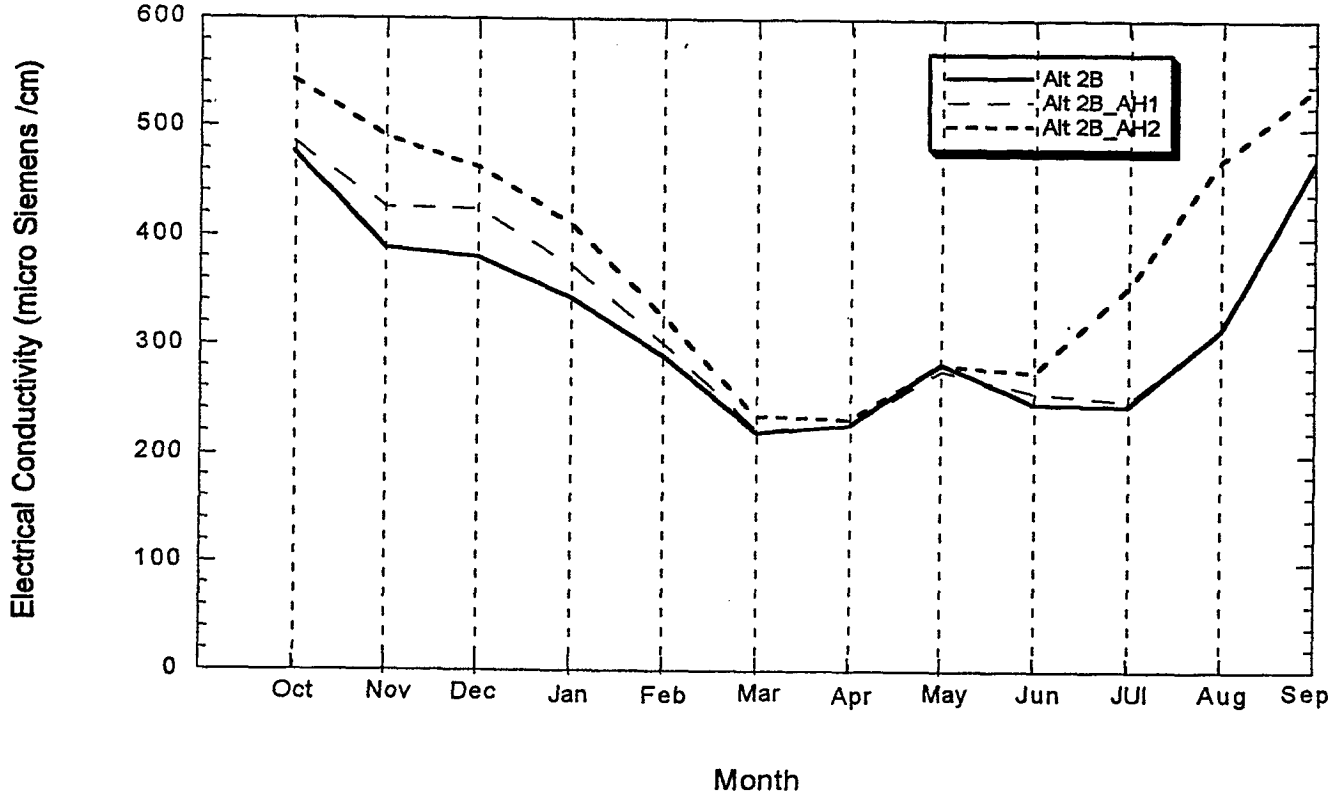


Figure 32: Clifton Court Forebay (Monthly Average EC)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

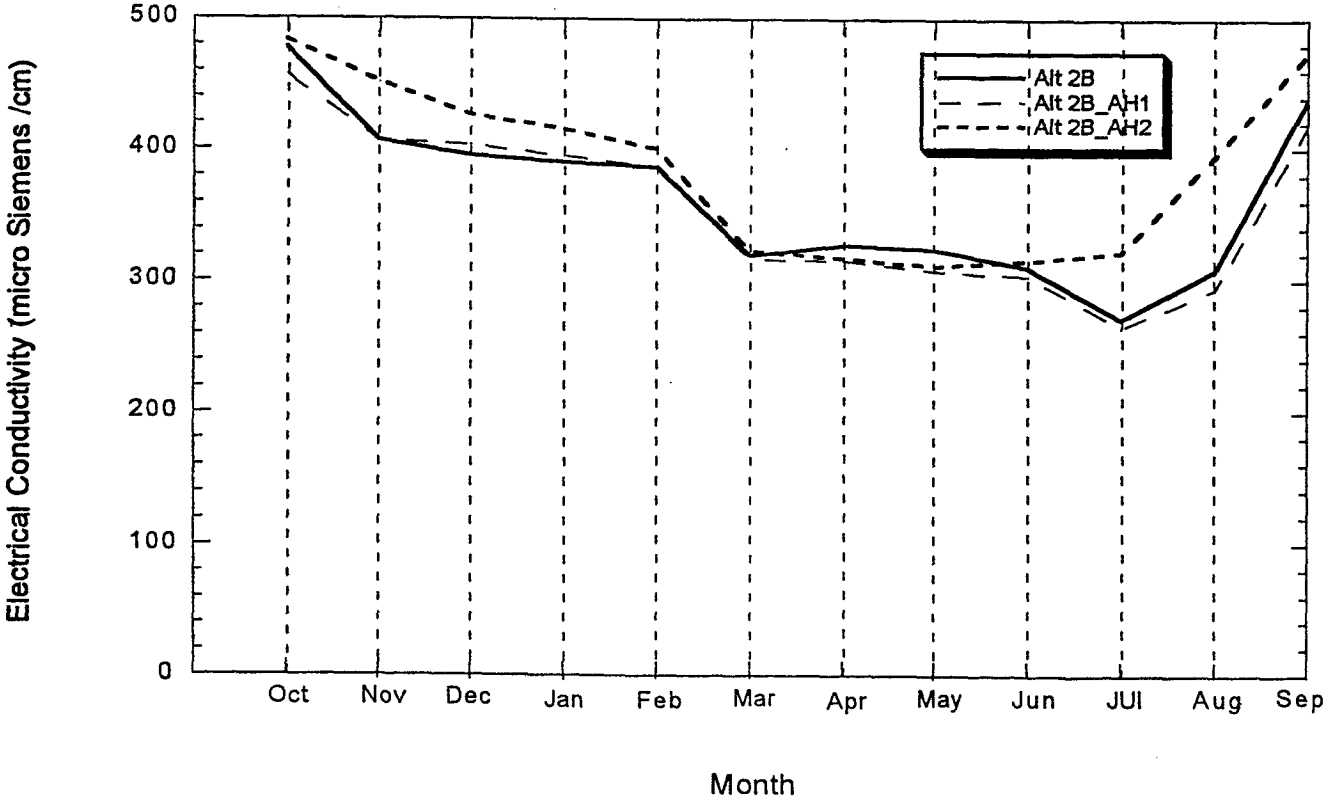
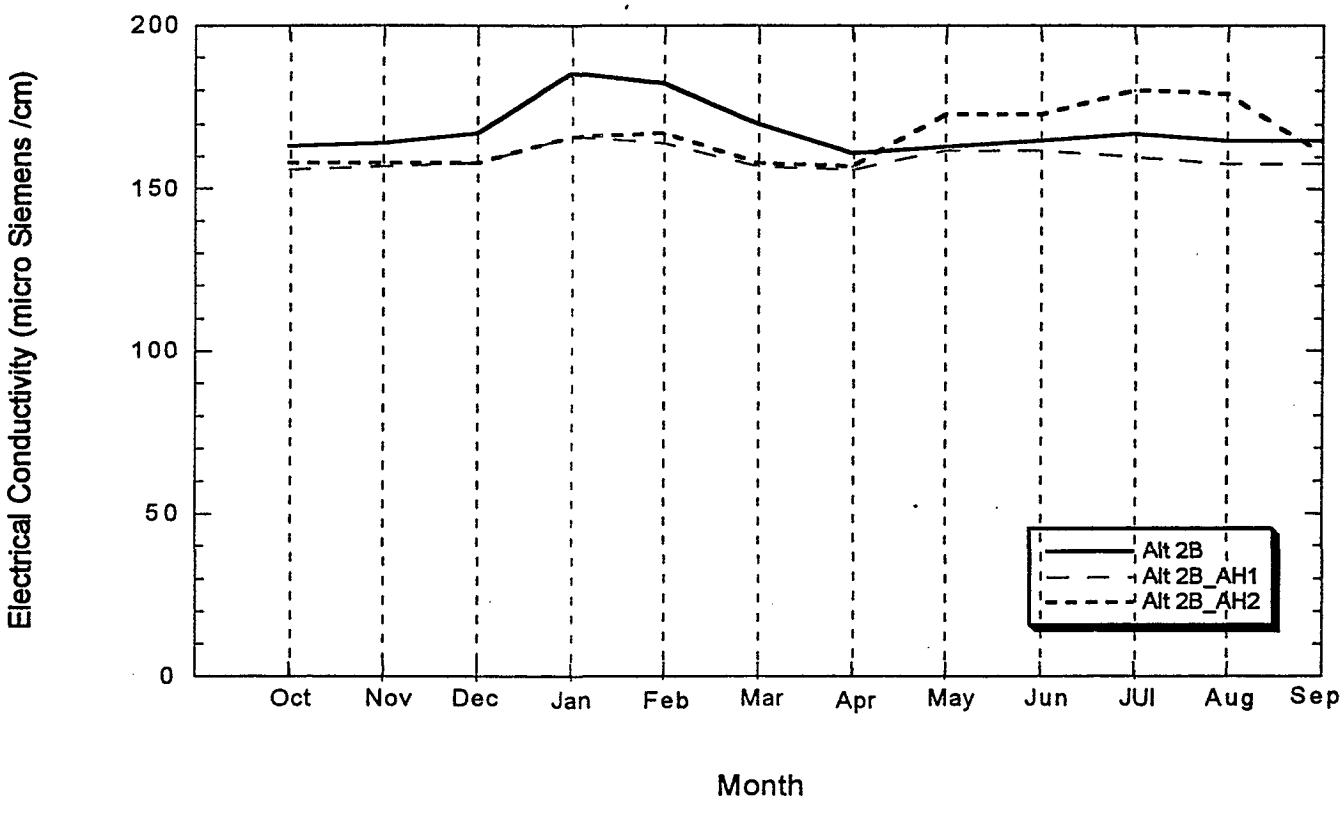


Figure 32a: Terminous (Monthly Average EC)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)



Water Levels

All three alternatives include south Delta flow control structures in Middle River, Grant Line Canal, and Old River near the existing DMC intake. These structures operate to raise water levels upstream of their locations while also maintaining or improving circulation patterns. All alternatives also operate a fish control structure at the Head of Old River in the spring and fall. This structure makes a complete closure in Old River to keep migrating fish out of the south Delta. Monthly minimum water levels at 6 locations in the south Delta during the irrigation season of April - September are presented in Figures 33-38. The selected 6 locations are shown Map 6.

The water surface elevation between 2B_AH1 and 2B_AH2 are nearly identical for the selected six locations. Except for location Middle River upstream of Victoria canal south fork of Mokelumne improvements caused at least a tenth of a foot water level increase over Alternative 2B. However in the Middle River, water surface elevation for Alternative 2B gave slightly a higher value than 2B_AH1 and 2B_AH2.

Conclusions:

Water quality in most locations are same for Alternative 2B and 2B_AH1. This shows that improving the South Fork of Mokelumne instead of North Fork does not have a major impact on salinity. However Alternative 2B_AH2 produced higher EC values in most locations. This can be attributed to lower Cross Delta Flow.

Alternative 2B_AH1 and 2B_AH2 produced a higher water level in the South Delta than Alternative 2B. Most of the improvements were between 0.1ft - 0.2 ft.

Map 6

Output Locations for Minimum Water Levels

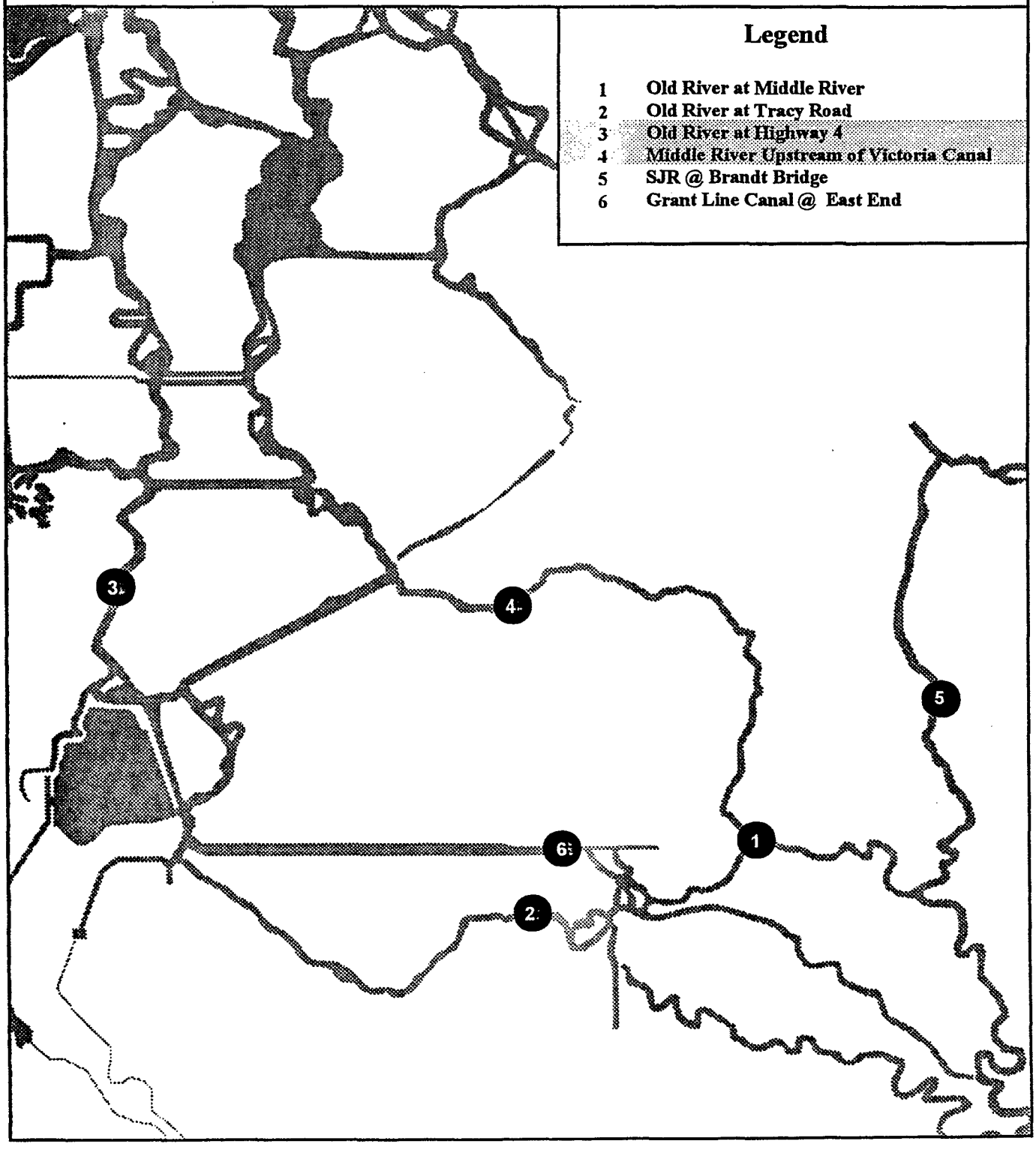


Figure 33: Old River at Middle River (Minimum Water Levels)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

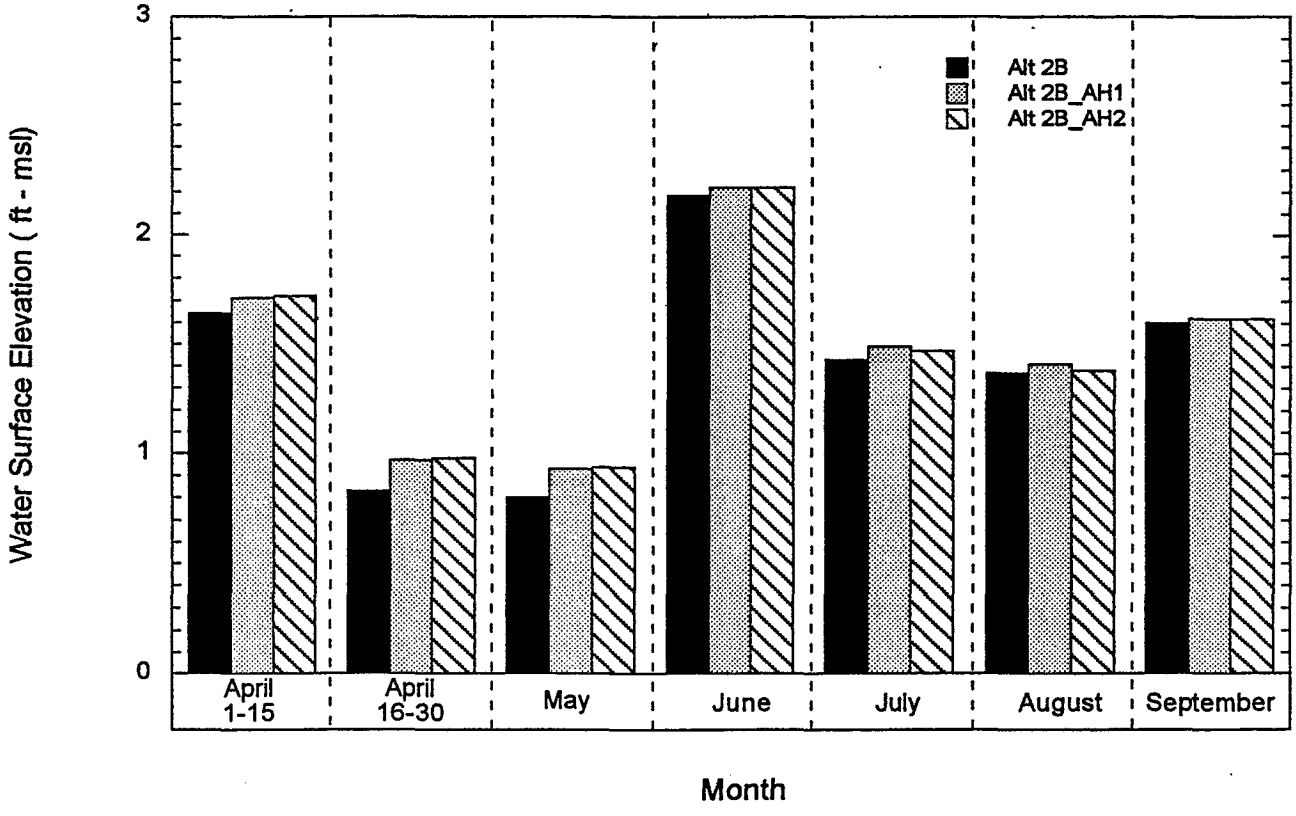


Figure 34: Old River at Tracy (Minimum Water Levels)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

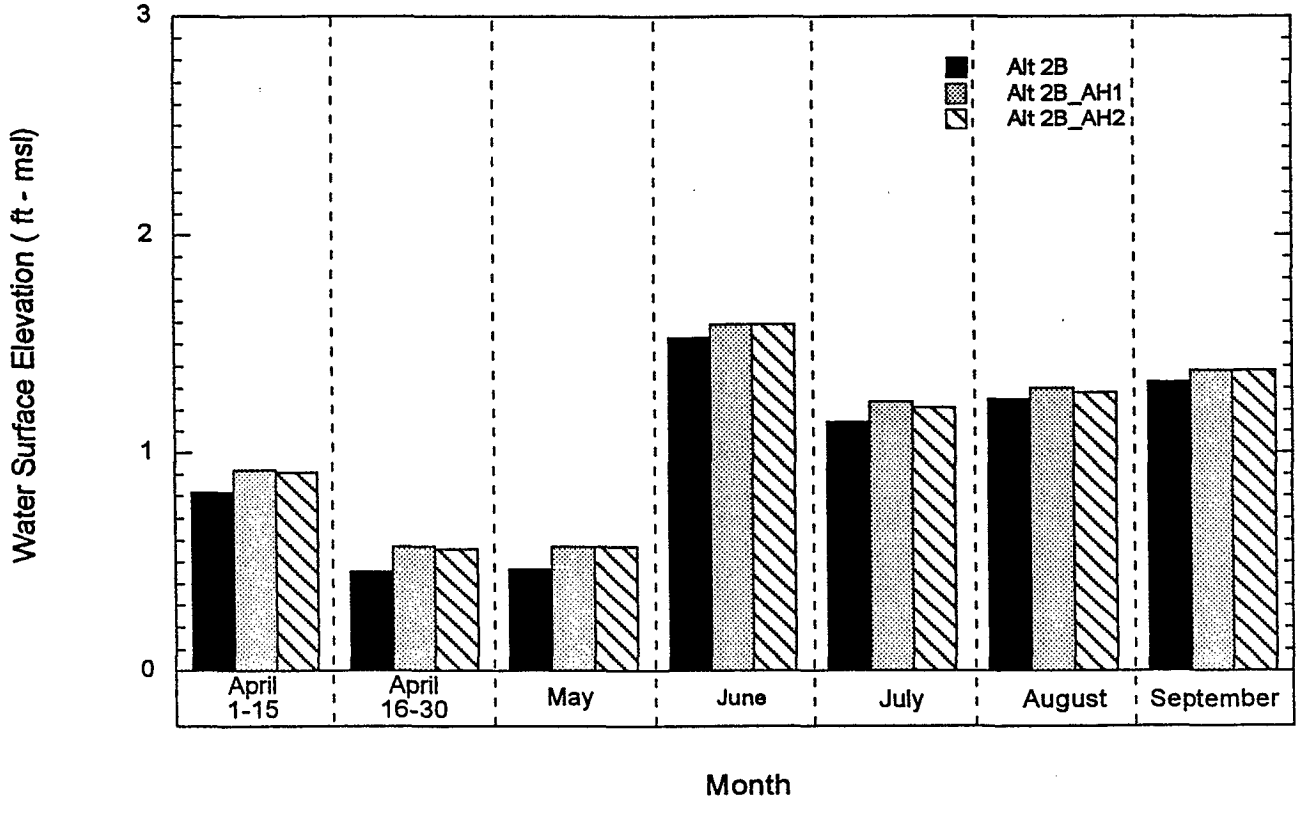


Figure 35: Old River at Highway 4 (Minimum Water Levels)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

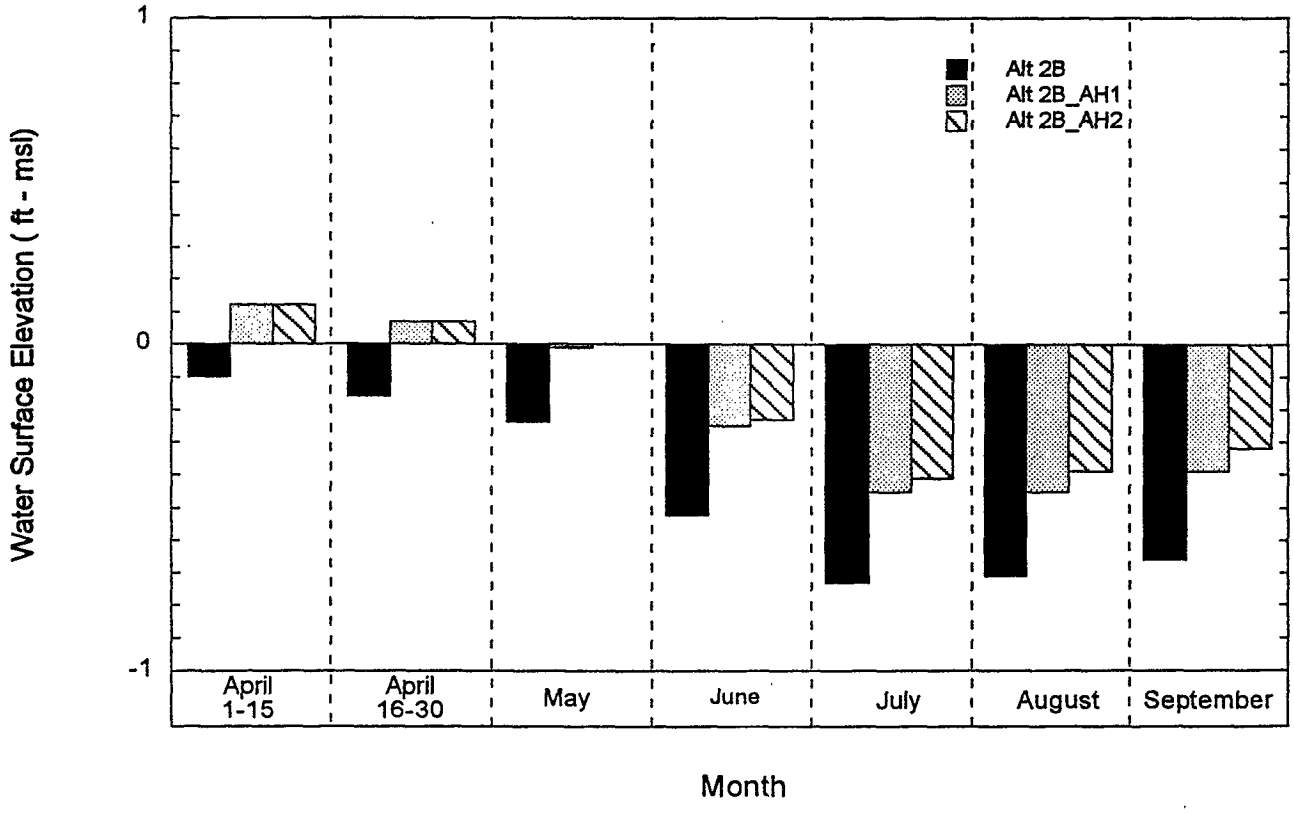


Figure 36: Middle River u/s of Victoria Canal (Minimum Water Levels)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

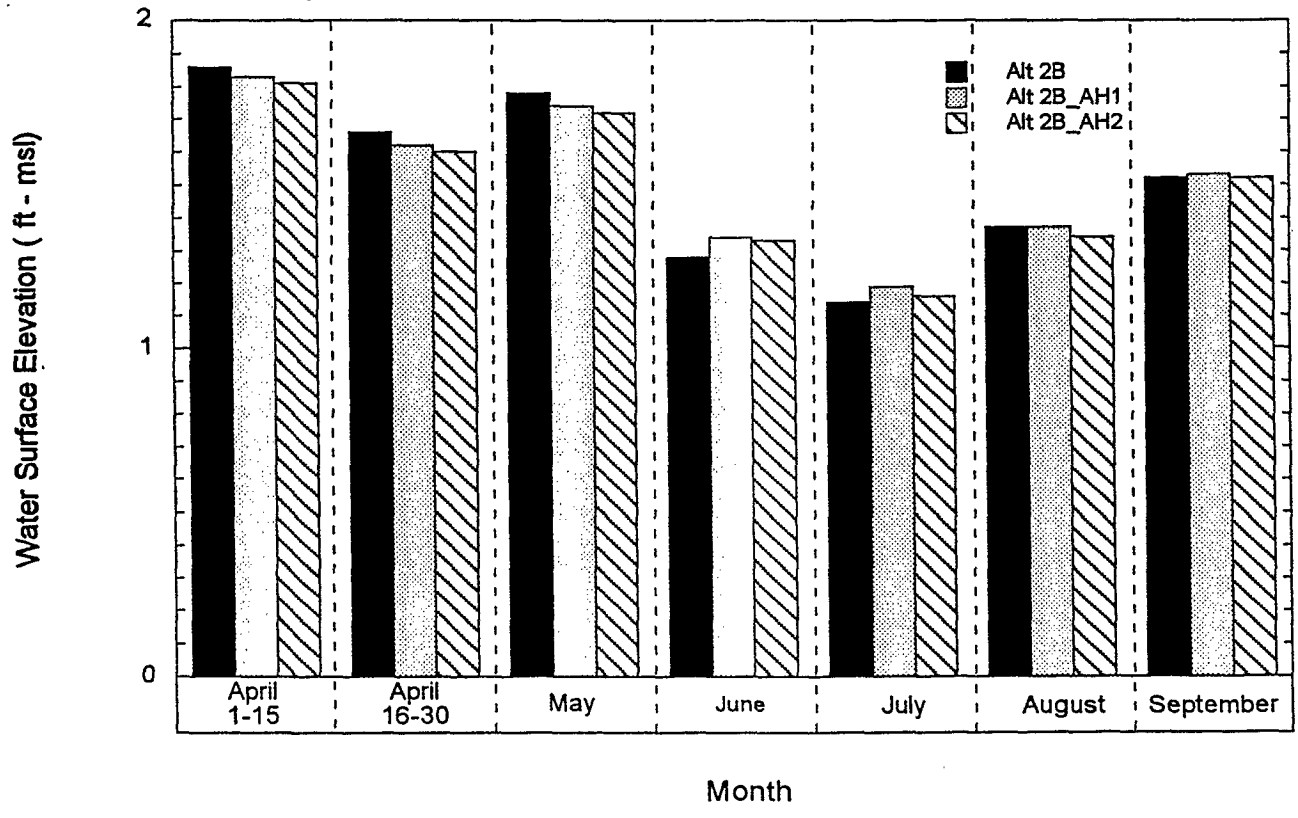


Figure 37: SJR at Brandt Bridge (Minimum Water Levels)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)

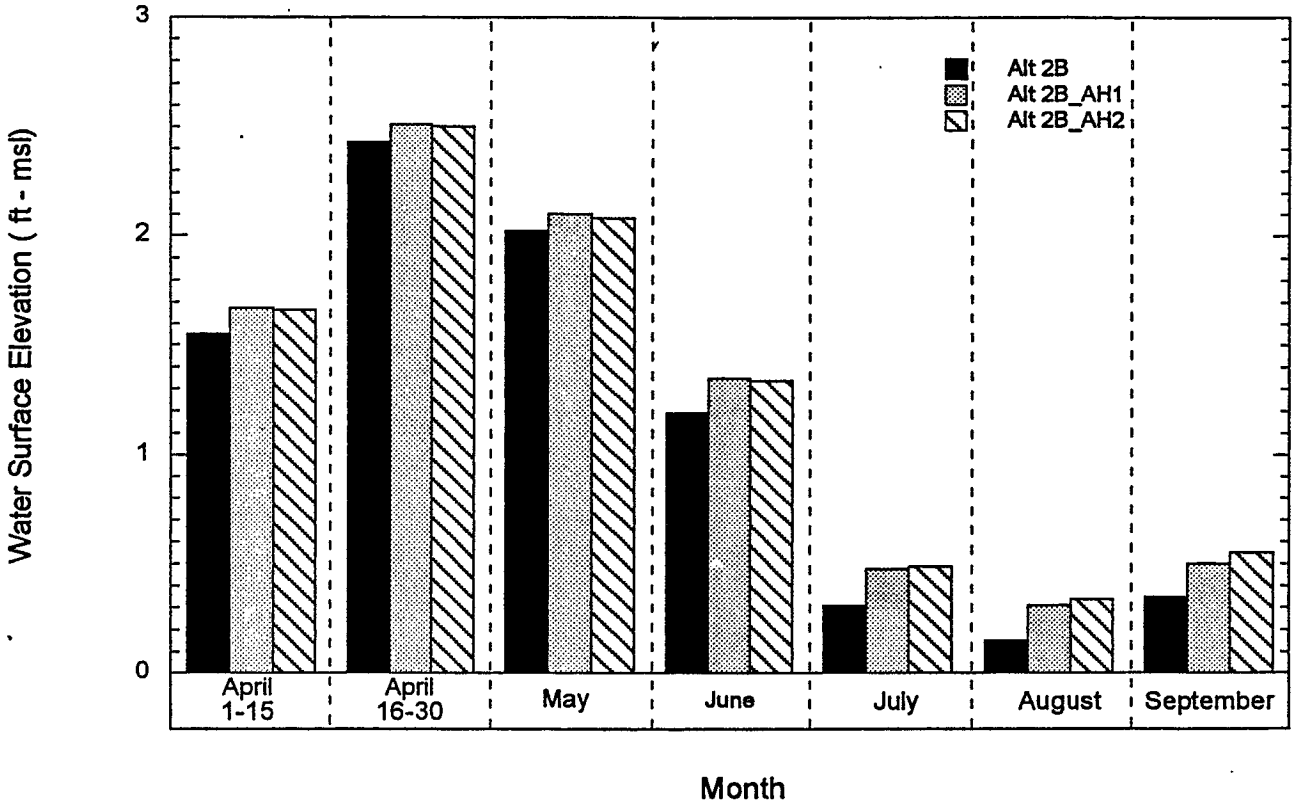
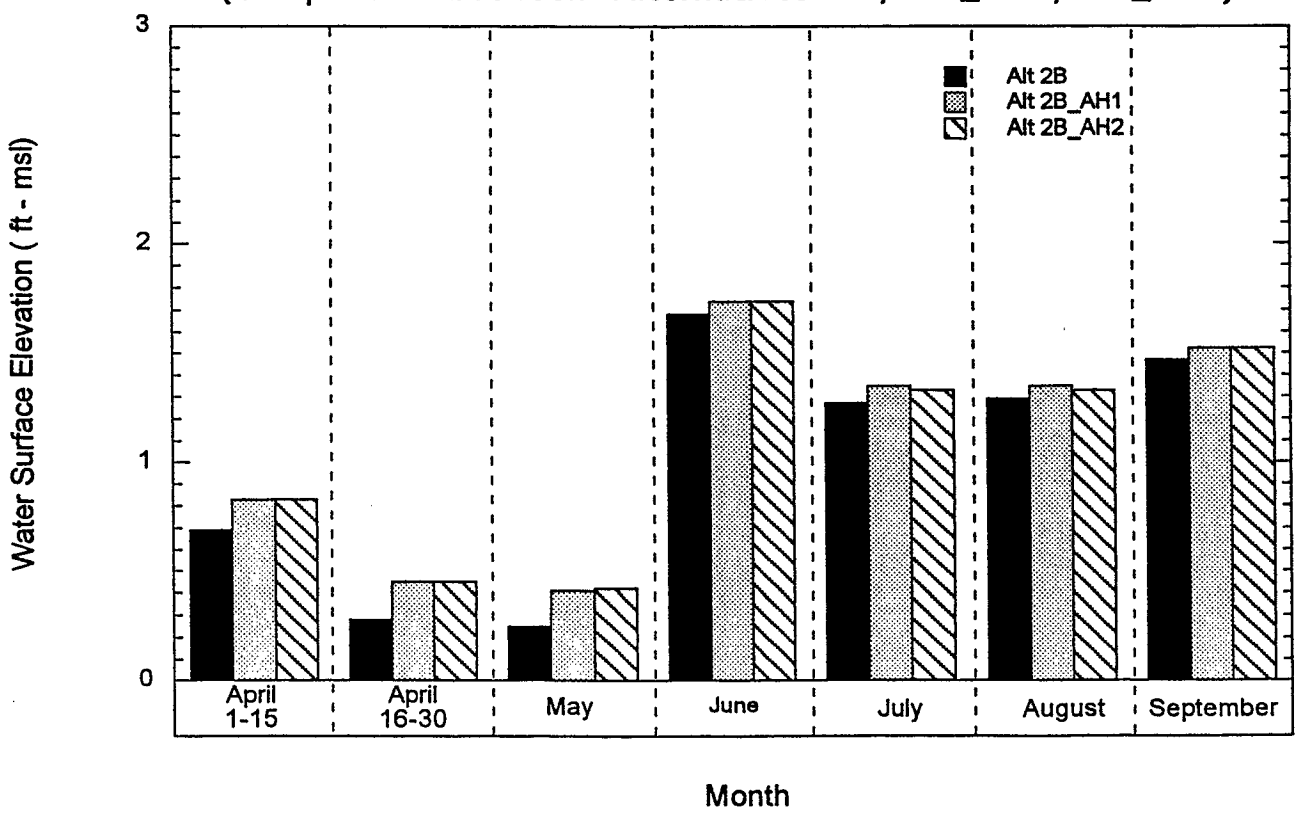


Figure 38: GLC at East End (Minimum Water Levels)
(Comparison between Alternatives 2B, 2B_AH1, 2B_AH2)



Appendix

Delta Hydrology

&

Delta Facility Operations

for alternatives

2B, 2B_AH1 and 2B_AH2

Appendix

Delta Hydrology

&

Delta Facility Operations

for alternatives

2B, 2B_AH1 and 2B_AH2

D-010984

Table 1-1
Delta Hydrology for Alternatives 2B, 2B_AH1 & 2B_AH2
DWRSIM Study 532a (Water Years 1976 - 1991)

(values in cfs)

Sacramento River Inflow at I Street

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1976	19,805	18,656	17,876	17,902	20,995	19,218	9,768	10,424	16,332	18,630	12,455	10,248
1977	10,339	7,990	8,095	12,185	21,685	7,138	8,893	7,509	11,527	7,704	6,316	7,870
1978	7,834	5,493	12,904	38,525	43,797	47,302	32,707	15,243	15,930	20,456	20,463	11,578
1979	12,432	13,599	13,874	21,544	36,663	31,803	14,689	13,000	21,040	23,778	18,206	12,333
1980	11,943	15,299	18,309	58,707	66,452	35,471	19,583	14,952	15,014	20,957	16,392	11,014
1981	11,563	13,075	16,732	24,396	24,563	30,975	17,463	13,000	13,789	23,367	18,090	12,215
1982	12,089	34,028	63,210	46,049	63,034	68,299	75,088	37,137	22,023	16,300	13,692	22,820
1983	27,008	39,644	57,049	60,141	83,437	82,260	69,237	54,223	54,990	22,576	19,262	26,808
1984	24,972	63,882	83,231	47,513	36,965	36,605	16,655	14,734	18,948	24,257	17,499	11,981
1985	12,195	32,874	19,385	17,708	20,597	23,020	11,191	15,284	14,250	22,901	17,468	11,674
1986	10,366	9,559	15,551	20,064	98,926	67,347	17,906	13,271	12,692	18,497	17,609	11,556
1987	12,622	11,307	12,454	15,119	21,502	28,148	13,240	13,000	13,760	23,088	17,944	11,969
1988	11,439	9,569	16,771	20,901	16,612	12,451	9,538	9,678	15,922	22,319	16,421	8,072
1989	7,867	9,071	9,127	12,109	11,360	38,898	19,170	15,005	14,191	23,621	18,431	11,764
1990	11,866	9,149	14,839	20,320	15,729	13,485	11,895	7,029	12,792	8,879	6,454	8,182
1991	9,295	8,433	8,457	7,381	12,121	30,519	12,854	8,290	10,067	8,758	10,234	9,439

San Joaquin River at Vernalis

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1976	3,510	1,787	2,025	1,643	2,123	2,183	2,212	1,706	832	643	820	1,276
1977	2,824	2,189	1,636	1,300	1,332	1,533	1,791	1,770	710	881	831	1,084
1978	1,265	1,412	1,481	3,488	7,391	11,484	16,182	13,423	8,277	3,045	1,824	2,782
1979	4,272	2,279	2,104	4,135	7,820	8,124	6,320	7,089	3,310	1,715	1,667	2,066
1980	2,902	1,744	2,302	11,720	19,220	14,038	7,097	8,678	8,133	3,874	1,866	2,635
1981	4,680	2,049	1,834	2,115	2,674	2,622	2,866	2,258	1,420	856	924	1,510
1982	2,000	1,665	2,032	6,802	14,473	14,259	27,771	18,958	10,649	3,511	3,011	5,833
1983	8,609	8,636	18,028	23,028	35,786	41,075	21,185	22,672	37,536	15,069	3,417	7,527
1984	7,718	13,528	20,845	13,480	8,731	6,347	4,301	4,563	2,528	1,807	1,889	2,253
1985	2,000	1,916	2,071	1,873	2,735	2,430	2,923	2,462	1,420	905	924	1,554
1986	2,000	1,547	1,652	1,854	24,101	25,489	11,053	10,163	9,284	1,718	1,813	2,012
1987	3,587	1,685	1,796	1,696	1,952	2,348	2,436	1,843	823	791	882	1,441
1988	1,839	1,379	1,237	1,216	1,326	1,396	2,152	1,788	710	436	731	1,060
1989	1,172	1,261	1,278	1,218	1,337	1,683	2,665	2,642	710	962	869	1,401
1990	1,318	1,276	1,181	1,229	1,398	1,459	2,631	2,353	710	547	668	1,280
1991	1,243	1,237	1,147	1,136	1,178	2,447	2,969	2,581	716	601	659	1,195

Department of Water Resources, Delta Modeling Section

Table 1-1 (cont.)
Delta Hydrology for Alternatives 2B, 2B_AH1 & 2B_AH2
DWRSIM Study 532a (Water Years 1976 - 1991)

(values in cfs)

Yolo Bypass Inflow

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1976	146	0	49	16	18	163	118	81	67	49	407	168
1977	49	34	49	65	54	146	168	537	67	146	81	34
1978	49	202	764	14,182	6,842	16,800	1,042	49	67	244	81	50
1979	65	118	33	797	648	228	50	65	67	114	49	50
1980	65	101	1,057	31,177	43,629	15,044	50	211	286	211	211	50
1981	65	34	146	488	594	195	50	65	101	98	81	50
1982	33	3,260	23,224	20,736	22,111	5,139	36,569	293	67	65	49	17
1983	130	1,613	10,571	20,866	58,628	113,532	15,444	3,058	840	49	49	50
1984	33	5,428	46,562	14,979	882	553	118	81	67	49	49	50
1985	1,382	1,109	49	146	216	65	50	65	67	49	49	50
1986	49	303	683	49	88,770	55,117	1,025	65	67	49	49	50
1987	65	34	98	146	288	423	84	81	67	49	49	50
1988	33	118	488	1,236	108	65	84	65	50	49	49	50
1989	65	84	228	81	90	537	101	81	67	49	49	17
1990	16	50	33	325	756	33	168	49	67	49	49	50
1991	65	0	65	33	126	748	50	65	67	49	49	50

Contra Costa Canal Diversion

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1976	220	187	148	120	103	197	0	145	249	164	168	279
1977	241	66	49	115	162	197	180	241	249	324	273	279
1978	241	193	177	143	162	99	111	220	281	511	538	464
1979	413	183	172	120	103	200	0	220	474	329	356	264
1980	236	183	146	120	63	99	0	220	418	327	355	264
1981	236	188	146	120	103	99	0	220	430	332	356	264
1982	236	185	145	120	103	34	0	220	479	327	355	264
1983	233	185	145	120	103	99	0	220	410	329	356	279
1984	223	143	181	122	104	99	0	220	435	329	356	281
1985	224	183	145	120	103	99	0	220	434	330	356	264
1986	237	150	145	120	56	150	0	220	420	327	355	264
1987	234	183	145	120	103	99	0	0	437	329	338	264
1988	96	71	99	120	103	99	0	220	281	153	231	103
1989	213	183	145	120	103	99	111	220	481	511	538	264
1990	213	183	145	120	103	197	0	241	249	250	233	166
1991	184	193	177	143	162	197	180	241	249	324	273	279

Department of Water Resources, Delta Modeling Section

Table 1-1 (cont.)
Delta Hydrology for Alternatives 2B, 2B_AH1 & 2B_AH2
DWRSIM Study 532a (Water Years 1976 - 1991)

(values in cfs)

Banks Pumping

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1976	10,019	8,385	7,349	5,767	6,775	5,851	1,415	1,508	4,598	10,300	7,515	3,013
1977	4,215	4,113	4,049	6,907	9,882	748	607	452	491	337	220	1,782
1978	769	1,630	6,285	10,157	10,251	10,186	5,573	3,228	4,307	10,300	10,162	4,987
1979	6,638	6,294	6,317	10,300	10,299	7,367	2,231	2,177	4,979	10,300	8,551	5,079
1980	5,386	7,050	10,300	10,234	10,066	8,182	2,685	2,611	4,351	10,300	7,353	5,041
1981	6,444	5,532	8,252	10,300	7,374	7,363	2,116	1,660	2,738	10,300	8,014	4,654
1982	5,349	10,300	10,300	10,275	8,762	7,346	7,124	5,851	7,476	4,032	5,431	10,300
1983	10,300	10,077	7,218	4,053	4,426	4,337	5,647	5,292	7,359	8,396	9,380	7,450
1984	5,292	4,662	4,302	4,404	5,479	5,766	2,225	1,969	3,935	9,503	7,046	5,187
1985	6,001	10,300	10,300	8,954	6,871	5,911	1,623	2,002	2,810	10,016	7,588	4,309
1986	3,969	4,525	7,894	10,225	10,200	7,021	4,219	2,725	4,353	7,616	7,178	4,933
1987	6,452	3,445	5,020	10,300	7,422	7,406	1,715	0	2,620	10,300	7,860	6,178
1988	4,127	4,013	8,481	10,300	5,408	3,236	1,390	1,428	2,975	10,262	10,257	1,279
1989	523	3,567	3,720	4,651	180	10,261	2,233	2,007	2,705	10,265	8,179	4,382
1990	3,725	977	6,301	10,265	4,567	3,515	1,634	1,240	725	197	324	1,475
1991	1,692	2,862	2,810	1,531	860	8,155	1,720	1,296	95	99	1,790	2,037

Tracy Pumping

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1976	4,304	2,783	1,986	960	1,132	1,878	1,415	1,483	1,551	881	1,252	4,185
1977	2,118	1,758	1,387	2,018	558	972	1,289	727	763	46	1,289	2,762
1978	1,491	1,253	3,974	4,207	4,258	2,592	3,106	3,228	4,307	953	4,558	4,522
1979	4,389	4,289	4,207	4,207	4,238	4,071	2,231	2,177	3,685	4,599	4,599	4,488
1980	4,369	4,279	4,207	4,207	4,242	4,158	2,685	2,611	4,351	3,545	4,599	4,486
1981	4,368	4,279	4,207	4,207	2,323	3,068	2,116	413	2,738	4,599	4,599	4,475
1982	3,766	4,276	4,207	4,207	4,272	2,881	2,792	3,611	4,600	4,599	4,599	4,513
1983	4,384	4,286	2,823	1,246	1,261	1,886	2,984	3,562	4,600	4,599	4,599	3,275
1984	1,332	1,606	2,770	1,227	1,437	3,196	2,225	1,969	3,935	4,599	4,599	4,503
1985	4,378	4,283	4,207	4,207	4,252	3,090	1,623	2,002	2,810	4,599	4,599	4,475
1986	3,177	2,413	4,207	4,207	4,228	4,225	2,157	2,578	3,821	930	4,599	4,400
1987	4,316	4,256	4,165	1,032	1,051	2,014	1,715	0	2,620	4,599	4,599	2,434
1988	4,008	2,227	4,207	4,207	1,022	1,718	1,390	1,428	2,975	3,938	1,035	3,213
1989	1,635	2,804	3,183	4,207	730	4,225	2,233	2,007	2,705	4,599	4,599	4,382
1990	4,308	4,183	4,207	4,207	2,541	1,881	1,634	1,240	1,682	848	1,012	3,345
1991	2,120	2,272	2,516	2,157	379	4,225	1,720	1,452	1,426	884	3,435	3,721

Department of Water Resources, Delta Modeling Section

Table 1-1 (cont.)
Delta Hydrology for Alternatives 2B, 2B_AH1 & 2B_AH2
DWRSIM Study 532a (Water Years 1976 - 1991)

(values in cfs)

Delta Channel Depletions

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1976	732	874	943	49	414	1,382	1,681	3,285	4,151	4,229	1,903	1,328
1977	1,236	807	862	-114	504	1,008	2,185	1,610	4,134	4,294	2,667	1,294
1978	1,269	689	146	-5,009	-1,891	-1,610	420	2,342	4,117	4,229	2,830	1,513
1979	1,382	622	894	-2,179	-2,557	179	1,227	2,374	4,302	4,115	2,618	1,748
1980	862	723	-33	-2,700	-3,601	309	1,210	2,000	3,697	3,773	2,618	1,563
1981	1,334	891	748	-732	198	-293	1,580	2,488	4,453	4,342	2,830	1,513
1982	846	101	-520	-4,407	-612	-2,911	34	2,342	3,512	4,050	2,667	924
1983	781	-1,126	-829	-4,733	-3,547	-4,635	-50	1,968	4,033	4,050	2,732	1,395
1984	1,203	-17	-2,017	-146	-162	748	1,529	2,716	4,033	4,294	2,749	1,815
1985	813	-437	33	-504	36	-374	1,714	2,797	4,285	4,180	2,618	1,344
1986	1,122	387	49	-1,480	-5,906	-1,269	1,193	2,293	4,067	4,163	2,879	1,227
1987	1,301	908	829	-179	-378	-114	2,000	2,862	4,067	3,936	2,765	1,714
1988	1,171	672	276	-1,447	342	1,041	1,496	2,196	3,764	4,700	2,879	1,748
1989	1,334	672	618	-114	90	0	1,933	2,716	3,949	4,521	2,749	840
1990	976	756	927	-455	-270	992	1,899	1,155	4,201	4,456	2,830	1,714
1991	1,236	874	813	49	396	-504	1,529	2,049	3,210	4,391	2,700	1,832

Net Delta Outflow

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1976	8,510	8,535	9,822	12,927	15,119	12,665	7,793	5,984	6,897	4,000	3,000	3,000
1977	5,460	3,500	3,500	4,726	12,014	6,018	6,962	6,897	6,897	4,000	3,000	3,000
1978	5,454	3,500	5,130	49,939	47,413	66,989	43,393	20,293	11,472	8,000	4,448	3,000
1979	4,000	4,768	4,500	15,602	36,320	30,796	16,317	13,725	11,191	6,500	4,000	3,000
1980	4,017	5,073	7,602	95,355	124,949	54,474	21,266	17,894	11,922	8,000	4,431	3,165
1981	4,115	4,500	5,719	14,049	18,329	25,266	15,076	10,768	5,164	5,000	3,500	3,000
1982	4,000	25,264	76,176	69,916	95,855	87,441	142,744	48,217	18,313	8,000	4,766	13,756
1983	20,532	40,385	85,516	113,205	189,051	254,556	102,736	75,920	81,110	21,988	7,215	23,563
1984	25,105	83,668	156,708	74,203	42,912	35,632	16,258	13,609	10,041	8,000	5,249	3,000
1985	4,432	23,143	7,552	7,389	13,372	17,895	9,898	11,081	5,613	5,000	3,500	3,000
1986	4,000	4,500	6,241	9,991	222,135	146,904	24,118	17,113	10,571	8,000	5,185	3,396
1987	4,126	4,500	4,500	6,065	16,472	22,639	10,538	12,355	5,104	5,000	3,500	3,000
1988	4,000	4,500	6,361	10,741	11,400	7,960	7,733	6,401	6,897	4,000	3,000	3,000
1989	5,454	3,500	3,500	4,731	12,001	28,105	15,814	11,131	5,506	5,000	3,500	3,489
1990	4,000	4,500	4,500	8,079	11,400	8,752	9,855	5,739	6,951	4,000	3,000	3,000
1991	5,438	3,500	3,500	4,744	11,966	23,244	10,945	6,092	6,121	4,000	3,000	3,000

Department of Water Resources, Delta Modeling Section

Table 1-2
Operation of Delta Facilities

Delta Cross Channel (Alternatives 2B and 2B_AH1)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1976	O	X	X	X	X	X	X	X	X	O	O	O
1977	O	X	X	X	X	X	X	X	X	O	O	O
1978	O	X	X	X	X	X	X	X	X	O	O	O
1979	O	X	X	X	X	X	X	X	X	O	O	O
1980	O	X	X	X	X	X	X	X	X	O	O	O
1981	O	X	X	X	X	X	X	X	X	O	O	O
1982	O	X	X	X	X	X	X	X	X	O	O	O
1983	X	X	X	X	X	X	X	X	X	O	O	X
1984	O	X	X	X	X	X	X	X	X	O	O	O
1985	O	X	X	X	X	X	X	X	X	O	O	O
1986	O	X	X	X	X	X	X	X	X	O	O	O
1987	O	X	X	X	X	X	X	X	X	O	O	O
1988	O	X	X	X	X	X	X	X	X	O	O	O
1989	O	X	X	X	X	X	X	X	X	O	O	O
1990	O	X	X	X	X	X	X	X	X	O	O	O
1991	O	X	X	X	X	X	X	X	X	O	O	O

Delta Cross Channel (Alternative 2B_AH2)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1976	X	X	X	X	X	X	X	X	X	X	X	X
1977	X	X	X	X	X	X	X	X	X	X	X	X
1978	X	X	X	X	X	X	X	X	X	X	X	X
1979	X	X	X	X	X	X	X	X	X	X	X	X
1980	X	X	X	X	X	X	X	X	X	X	X	X
1981	X	X	X	X	X	X	X	X	X	X	X	X
1982	X	X	X	X	X	X	X	X	X	X	X	X
1983	X	X	X	X	X	X	X	X	X	X	X	X
1984	X	X	X	X	X	X	X	X	X	X	X	X
1985	X	X	X	X	X	X	X	X	X	X	X	X
1986	X	X	X	X	X	X	X	X	X	X	X	X
1987	X	X	X	X	X	X	X	X	X	X	X	X
1988	X	X	X	X	X	X	X	X	X	X	X	X
1989	X	X	X	X	X	X	X	X	X	X	X	X
1990	X	X	X	X	X	X	X	X	X	X	X	X
1991	X	X	X	X	X	X	X	X	X	X	X	X

Note: 'X' denotes gates closed, 'O' denotes gates open

D-010989

Table 1-2 (cont.)
Operation of Delta Facilities
nder
Alternatives 2B, 2B_AH1 & 2B_AH2

South Delta Flow Control Structures

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr (1-15)	Apr (16-30)	May	Jun	Jul	Aug	Sep
1976	2	0	0	0	0	0	2	2	2	3B	3A	3A	3B
1977	2	0	0	0	0	0	2	2	2	3A	3B	3A	3A
1978	2	0	0	0	0	0	2	2	2	3C	3C	3B	3C
1979	2	0	0	0	0	0	2	2	2	3C	3B	3B	3B
1980	2	0	0	0	0	0	2	2	2	3C	3C	3B	3B
1981	2	0	0	0	0	0	2	2	2	3B	3B	3A	3B
1982	2	0	0	0	0	0	0	0	2	3C	3C	3C	3C
1983	2	0	0	0	0	0	0	0	0	0	3C	3C	3C
1984	2	0	0	0	0	0	2	2	2	3B	3B	3B	3B
1985	2	0	0	0	0	0	2	2	2	3B	3B	3A	3B
1986	2	0	0	0	0	0	2	2	2	3C	3B	3B	3B
1987	2	0	0	0	0	0	2	2	2	3B	3A	3A	3B
1988	2	0	0	0	0	0	2	2	2	3A	3A	3A	3A
1989	2	0	0	0	0	0	2	2	2	3A	3B	3A	3B
1990	2	0	0	0	0	0	2	2	2	3A	3A	3A	3B
1991	2	0	0	0	0	0	2	2	2	3A	3A	3A	3A

Note: '0' denotes no structures operating, '2' denotes Old River and middle River Operating, '3' denotes all three structures operating. 'A' -GLC with special operation, 'B' - GLC and Old River with special operation, C' - GLC, Old River and Middle River structures with special operation.

Head of Old River Fish Control Structure

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr (1-15)	Apr (16-30)	May	Jun	Jul	Aug	Sep
1976	O	O	N	N	N	N	N	O	O	N	N	N	N
1977	O	O	N	N	N	N	N	O	O	N	N	N	N
1978	O	O	N	N	N	N	N	N	N	N	N	N	N
1979	O	O	N	N	N	N	N	O	O	N	N	N	N
1980	O	O	N	N	N	N	N	O	N	N	N	N	N
1981	O	O	N	N	N	N	N	O	O	N	N	N	N
1982	O	O	N	N	N	N	N	N	N	N	N	N	N
1983	N	N	N	N	N	N	N	N	N	N	N	N	N
1984	O	N	N	N	N	N	N	O	O	N	N	N	N
1985	O	O	N	N	N	N	N	O	O	N	N	N	N
1986	O	O	N	N	N	N	N	N	N	N	N	N	N
1987	O	O	N	N	N	N	N	O	O	N	N	N	N
1988	O	O	N	N	N	N	N	O	O	N	N	N	N
1989	O	O	N	N	N	N	N	O	O	N	N	N	N
1990	O	O	N	N	N	N	N	O	O	N	N	N	N
1991	O	O	N	N	N	N	N	O	O	N	N	N	N

Note: 'N' denotes gates not operating, 'O' denotes gates are operating to make complete closure

Table 1-2 (cont.)
Operation of Delta Facilities under Alternatives 2B, 2B_AH1 & 2B_AH2

Clifton Court Forebay Intake Gate Priority

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1976	4	4	4	4	4	4	3	3	3	4	4	4
1977	4	4	4	4	4	4	3	3	3	4	4	4
1978	4	4	4	4	4	4	3	3	3	4	4	4
1979	4	4	4	4	4	4	3	3	3	4	4	4
1980	4	4	4	4	4	4	3	3	3	4	4	4
1981	4	4	4	4	4	4	3	3	3	4	4	4
1982	4	4	4	4	4	4	3	3	4	4	4	4
1983	4	4	4	4	4	4	3	3	3	4	4	4
1984	4	4	4	4	4	4	3	3	3	4	4	4
1985	4	4	4	4	4	4	3	3	3	4	4	4
1986	4	4	4	4	4	4	3	3	3	4	4	4
1987	4	4	4	4	4	4	3	3	3	4	4	4
1988	4	4	4	4	4	4	3	3	3	4	4	4
1989	4	4	4	4	4	4	3	3	3	4	4	4
1990	4	4	4	4	4	4	3	3	3	4	4	4
1991	4	4	4	4	4	4	3	3	3	4	4	4

Note: See Figure 8 in January 16,1998 Report for description of the values

Suisun Marsh Salinity Control Gates

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1976	O	O	O	O	O	O	O	O	N	N	N	N
1977	O	O	O	O	O	O	O	O	N	N	N	N
1978	N	N	N	N	N	N	N	N	N	N	N	N
1979	O	O	O	O	O	O	O	O	N	N	N	N
1980	N	N	N	N	N	N	N	N	N	N	N	N
1981	O	O	O	O	O	O	O	O	N	N	N	N
1982	N	N	N	N	N	N	N	N	N	N	N	N
1983	N	N	N	N	N	N	N	N	N	N	N	N
1984	N	N	N	N	N	N	N	N	N	N	N	N
1985	O	O	O	O	O	O	O	O	N	N	N	N
1986	N	N	N	N	N	N	N	N	N	N	N	N
1987	O	O	O	O	O	O	O	O	N	N	N	N
1988	O	O	O	O	O	O	O	O	N	N	N	N
1989	O	O	O	O	O	O	O	O	N	N	N	N
1990	O	O	O	O	O	O	O	O	N	N	N	N
1991	O	O	O	O	O	O	O	O	N	N	N	N

Note: 'N' denotes gates not operating, 'O' denotes gates are operating

Table 1-2 (cont.)
Operation of Delta Facilities

Monthly Average Flow Diverted from Sacramento River at Hood Into Snodgrass Slough for Alternatives 2B and 2B_AH1

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1976	10,000	10,000	9,335	6,727	7,907	7,729	2,830	2,991	6,149	10,000	5,295	3,088
1977	6,333	5,871	5,436	8,925	10,000	1,720	1,896	1,179	1,254	383	0	710
1978	2,260	2,883	10,000	10,000	10,000	10,000	8,679	5,000	8,614	10,000	10,000	4,418
1979	10,000	10,000	10,000	10,000	10,000	10,000	4,462	4,354	8,664	10,000	10,000	5,173
1980	9,755	10,000	10,000	10,000	10,000	10,000	5,370	5,000	8,702	10,000	9,232	3,854
1981	10,000	9,811	10,000	10,000	9,697	10,000	4,232	2,073	5,476	10,000	10,000	5,055
1982	9,115	10,000	10,000	10,000	10,000	10,000	9,916	5,000	10,000	8,631	6,532	10,000
1983	10,000	10,000	10,000	5,299	5,687	6,223	8,631	5,000	10,000	10,000	10,000	10,000
1984	8,520	6,268	7,072	5,631	6,916	8,962	4,450	3,938	7,870	10,000	10,000	4,821
1985	10,000	10,000	10,000	10,000	10,000	9,001	3,246	4,004	5,620	10,000	10,000	4,514
1986	7,146	6,938	10,000	10,000	10,000	10,000	6,376	5,000	8,174	8,546	10,000	4,396
1987	10,000	7,701	9,185	10,000	8,473	9,420	3,430	0	5,240	10,000	10,000	4,809
1988	8,135	6,240	10,000	10,000	6,430	4,954	2,780	2,856	5,950	10,000	9,261	912
1989	2,158	6,371	6,903	8,858	910	10,000	4,466	4,014	5,410	10,000	10,000	4,604
1990	8,033	5,160	10,000	10,000	7,108	5,396	3,269	2,480	2,407	1,045	0	1,022
1991	3,812	5,134	5,326	3,688	1,238	10,000	3,440	2,748	1,521	982	3,074	2,279

Monthly Average Flow Diverted from Sacramento River at Hood Into Snodgrass Slough for Alternative 2B_AH2

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1976	10,000	10,000	9,335	6,727	7,907	7,729	2,830	2,991	6,149	10,000	8,767	7,198
1977	6,333	5,871	5,436	8,925	10,000	1,720	1,896	1,179	1,254	383	1,509	4,544
1978	2,260	2,883	10,000	10,000	10,000	10,000	8,679	5,000	8,614	10,000	10,000	8,578
1979	10,000	10,000	10,000	10,000	10,000	10,000	4,462	4,354	8,664	10,000	10,000	9,333
1980	9,755	10,000	10,000	10,000	10,000	10,000	5,370	5,000	8,702	10,000	10,000	8,014
1981	10,000	9,811	10,000	10,000	9,697	10,000	4,232	2,073	5,476	10,000	10,000	9,129
1982	9,115	10,000	10,000	10,000	10,000	10,000	9,916	5,000	10,000	8,631	10,000	10,000
1983	10,000	10,000	10,000	5,299	5,687	6,223	8,631	5,000	10,000	10,000	10,000	10,000
1984	8,520	6,268	7,072	5,631	6,916	8,962	4,450	3,938	7,870	10,000	10,000	8,981
1985	10,000	10,000	10,000	10,000	10,000	9,001	3,246	4,004	5,620	10,000	10,000	8,674
1986	7,146	6,938	10,000	10,000	10,000	10,000	6,376	5,000	8,174	8,546	10,000	8,556
1987	10,000	7,701	9,185	10,000	8,473	9,420	3,430	0	5,240	10,000	10,000	8,612
1988	8,135	6,240	10,000	10,000	6,430	4,954	2,780	2,856	5,950	10,000	10,000	4,492
1989	2,158	6,371	6,903	8,858	910	10,000	4,466	4,014	5,410	10,000	10,000	8,764
1990	8,033	5,160	10,000	10,000	7,108	5,396	3,269	2,480	2,407	1,045	1,337	4,820
1991	3,812	5,134	5,326	3,688	1,238	10,000	3,440	2,748	1,521	982	5,225	5,757

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